

COMMONWEALTH OF PENNSYLVANIA.

BULLETIN No. 2.

DEPARTMENT OF FISHERIES.

Pennsylvania's Fish Cultural Work

AND

EXHIBIT AT WORLD'S FAIR, ST. LOUIS, 1904.

COMPILED BY

M. J. MELLINGER.

Issued May, 1904.

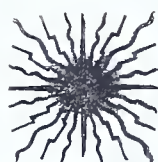
WM. STANLEY RAY,
STATE PRINTER OF PENNSYLVANIA,
1904.



INTRODUCTION.

“Pennsylvania’s Work in Fish Culture” was prepared in order that visitors to the Louisiana Purchase Exposition, and people residing in other states, who are interested in the increase of fish life, may have a clear understanding of what has been done by the great Commonwealth of Pennsylvania in that direction. From the earliest days of fish culture in the United States, Pennsylvania has been among the foremost in hatching and protecting fish. Its fish laws, as a whole, are models which many states might copy with advantage, and indeed, some have modeled their statutes on them. When the small amount of money expended on fish culture is taken into consideration the annual number of fish hatched and planted is phenomenally large, comparing favorably even with the work done by the United States Government, and all admit the splendid results achieved by the National Government.

The pamphlet “Pennsylvania’s Work in Fish Culture” is an exhaustive and careful review of Pennsylvania’s work during the last thirty-four years.



PENNSYLVANIA'S FISHERY EXHIBIT AT THE WORLD'S FAIR.

Acting under the authority of the Pennsylvania Commission to the Louisiana Purchase Exposition, the Department of Fisheries made application, in July, 1903, for space in the Forestry, Fish and Game Building, on the World's Fair Grounds, St. Louis. Dr. Tarleton H. Bean, the Director of the building, awarded a space of nearly 4,000 square feet at the east side of the north end of the building, directly opposite one of the main entrances. The space was L shaped, the upright stem of the letter being 97 feet long, and flanking both sides of a fifteen foot aisle. On this section the Department built a grotto of white pine in natural wood finish for the display of live fish in thirty-five aquariums ranging in size from four to six feet each.

The aquariums were carefully enclosed so that no parts of them were visible excepting the front glass. With a strong light thrown from the back the fish swimming in the aquariums would be more clearly shown. Over each aquarium was placed a paper label, fronted by glass, setting forth briefly the name, habits and value of the fish exhibited. In addition fifty photographic transparencies, illustrating picturesque fishing waters in Pennsylvania, were set in the wood work in such a manner as would permit their illumination. At each end of the grotto was hung a neat sign bearing the words "Pennsylvania Department of Fisheries." The whole grotto with the aquariums, labels and photographic transparencies made a display which when completed attracted much attention and emphatic expressions of admiration on account of its beauty.

At the east end of the grotto on the south side a strong volume of water flows over a pretty fall eight feet high into a stream which taking a circular course empties into a large pool sunk in the floor in the foot of the L shaped space. In the stream are small fishes and in the pool large specimens of sturgeon, carp and lake trout. In the foot of the L is also placed an aquarium containing gold fish, which are raised in the State hatcheries for educational purposes in the public schools. The greater part of the space however is devoted to mounted specimens, angling and commercial fishing devices, photographs and water color drawings.

Bordering the pool is an enclosure containing huge specimens of a sturgeon and a porpoise, and near by is a model of one of the hatchery buildings at the Corry hatchery. Starting from one corner is a huge trap net with its wings extending right and left to the limits of the space, forming a net fence preventing too close an approach to the pictures and other exhibits. On the north end of the space is a wall eight feet high and thirty-four feet long completely covered with photographs and water color drawings, some owned by the Department and others loaned. Beginning at the east end is a series of forty photographs illustrating the hatching of brook trout. There are several views showing the hatching houses both exterior and interior. They are followed by others showing the ponds in which the fish are kept, and the feeding of the trout. A close inspection of the photographs will show the fish in the water and the splashes made by the leaping fish are plainly visible. The catching of the fish, the taking of the eggs, the eggs in the hatching troughs, and the little fish in the same troughs after they have been hatched are plainly visible. The series ends by photographs showing the cans loaded with fish ready to be taken to the railroad and the emptying of the little creatures in the stream. It is an exceedingly valuable series. Following are two or more dozen water color drawings of the principal game, food and inferior fishes in Pennsylvania waters. More than one-half the exhibit is loaned by the Pennsylvania Fish Protective Association of Philadelphia, the oldest and one of the most influential organizations of the kind in Pennsylvania. There is also an exquisite water color of a chain pickerel loaned by Miss Margaret J. Mellinger, of Philadelphia, the compiler of this pamphlet. The series closes with five finely executed water color paintings illustrating the delights of angling, by Mr. Frank H. Taylor, a well known Philadelphia artist, who loaned them to the Department for exhibition purposes.

At the west side of the exhibit is a high wall twelve feet high draped with illegal nets in Pennsylvania, and captured by the wardens of the Department of Fisheries, and studded with mounted specimens of fish captured when alive in Pennsylvania waters. There are lake trout weighing nearly forty pounds, huge carp, extraordinarily large striped bass and black bass and other fishes beyond the normal size. Among them are a seven pound chain pickerel and an eight pound eel loaned by Mr. Weisbrod, of Philadelphia, and some fine bass and muscallonge, and muscallonge heads loaned by William Baird, of Cambridge Springs, fish caught from Conneaut lake. The fish are mounted on panels, and in connection with the nets make a notably display. The arrangement of the nets and fishes on this wall was considered a daring innovation in decorative art. Instead of striving for contrast by making a

background of burlap or some material which would bring the nets and fishes out sharply, they were arranged against the natural wood, oiled and varnished, without regard to the wood showing sappy and knotty. The result is a rich and somewhat dark background with an effect which becomes more and more pleasing the longer it is examined.

Near by is a spacious case of quartered oak containing a fine collection of angling goods loaned by E. K. Tyron, a prominent sporting goods dealer in Philadelphia. The exhibit is valued at several hundred dollars and is complete in every detail. There is not a thing used by anglers which is missing, and while there is no particular article of unusual value, it is of unusual attractiveness to sportsmen, because the articles are all such as anglers use when they go a fishing. There are some beautifully fashioned rods, so light and neat in construction that the beholder longs to take them from the case and go with them to the nearest stream and try them. Among those which attract the greatest attention is a three and one-half ounce trout fly rod and a five ounce bait casting rod. There is also a reel which can be taken apart without removing screws and hundreds of other articles which excite covetous thoughts. Adjoining the case of angling articles is a huge case of quartered oak filled with mounted specimens of birds and mammals which prey upon fish. These were artistically arranged in natural positions by Louis Weber, a Philadelphia taxidermist. Gulls are flying, land birds are in proper position on branches of trees and on the ground, and beavers, minks and other animals are preying on fishes. The collection is almost absolutely complete. Even the common house rat and the familiar house cat are not overlooked.

The case has a back of wood and arranged thereon are mounted game and food fishes in convex glasses. Most of them are the property of the Department of Fisheries, but one or two are loans.

The exhibit of the Department of Fisheries of Pennsylvania is the only one in the building which has space devoted entirely to the display of fish and of matters connected with fish exclusively. Many hours can be profitably spent in examining the many interesting objects. It is under the care of William Buller, the Superintendent of the Corry Hatchery.

W. E. MEEHAN,
Commissioner of Fisheries.

THE GROWTH OF THE FISH LAWS.

Pennsylvania began its work of fish culture in 1870. It has five hatching houses in operation and in the thirty-three years of the work more than 1,470,000,000 of game and food fishes have been hatched and distributed in the waters of the Commonwealth. From the figures submitted it will be observed that the bulk of this enormous output has been fishes which are, to use a term employed in the act of May 29, 1901, "commercially valuable for food."

The causes which led to the Commonwealth of Pennsylvania engaging in the work of fish culture were wasteful and extravagant fishing, extending over many years, which depleted the streams. A similar condition existed in many other states, and in response to a popular demand the legislatures of the New England and the Middle States appointed Commissions to investigate the extent of the trouble and report on the best method of restoring the fish. Pennsylvania appointed Mr. James Worrall in 1866.

Early in the year of 1866, a convention was held in Harrisburg to consider the fishery interests of the Commonwealth. At this convention, the construction of the dam across the Susquehanna at Columbia was discussed. It was explained how this dam prevented the passage of shad and other fishes up the river, to the serious detriment of a great commercial industry of the people of that locality. This and other conditions were explained and the result was that a law, fashioned after a Massachusetts enactment of 1865, was drawn with great care, passed promptly by the legislature, and with equal promptness received the Governor's signature. This was on March 30, 1866, and the immediate result of this act was the appointment of Mr. James Worrall, of Harrisburg, as Commissioner.

The new law provided for the erection of such devices in dams as would insure the free passage of fish up the river and its tributaries. The law required these devices to be constructed within six months and imposed a heavy fine upon such owners who failed to comply with its provisions.

Mr. Worrall found many difficulties with which to contend. Some corporations, such as the Tide Water Canal Company, promptly fulfilled their obligations even under heavy expense, while others not only refused to comply with the requests of Mr. Worrall, but waged long and bitter battles in the courts. These latter

corporations contended that as they purchased from the State, free of incumbrance, the dams above Columbia, the law infringed upon their rights and a legal battle of nearly four years ensued. The Dauphin County Court of Quarter Sessions sustained the contentions of the corporations, and when the cases were transferred to the Supreme Court, that tribunal also confirmed the verdict of the lower court.

Nor was this the only type of difficulty which confronted Mr. Worrall. Dip nets worked like sweeps, at close intervals, were kept in constant operation every spring. These nets were used to catch mullets, but the manner of operating them so intimidated the shad, as to drive them away from the face of the dam.

Through the efforts of Mr. Worrall, a fishway was constructed in the dam in the Susquehanna river at Columbia. The plan for this fishway was devised by the superintendent of the Canal Company, although some modifications suggested by Mr. Worrall were adopted. For the first two years after its construction it seemed to be a success, but after that the catches each year became smaller and smaller. Finally the fishway was abandoned as a failure, its weak points being soon recognized.

Despite the praiseworthy efforts made by the Commonwealth to improve the fishing, these efforts were frustrated by the people along the Susquehanna using every sort of device, legal or illegal, to catch shad. As a consequence, another law was passed by the legislature in 1868. This law made it "unlawful to fish with any seine or by any other system of entrapping in members within two hundred yards of any sluice or other device erected for the passage of fish as described in the act, or upon or about any dam in or upon which such sluice shall have been erected."

Although the first effort to restore the shad fisheries in the Susquehanna river was deemed more or less a failure, yet there were some features which encouraged perseverance. It was thought that greater and more efficient work could be accomplished by the appointment of several men as Commissioners. The work to be done was a herculean task for several men, to say nothing of one man. Accordingly on April 29, 1873, an act was passed providing for a Commission of Fisheries, to be composed of three persons. This Commission was invested with extensive powers and what was still more potent, an appropriation with which to carry on its work. Howard J. Reeder, Benjamin L. Hewitt and James Duffy were the gentlemen who comprised the first Commission under this new act.

This Commission as well as those which followed it, found several specific groups of difficulties against which to direct all their energies and resources. In the early days there were no laws at all

to regulate either fishermen or fisheries. Then laws were formulated and enacted which the Commissions found to be defective or inoperative. Many of them were unconstitutional. Laws were formulated by the Commissions and sometimes by members of the legislature themselves, without reference to the Commissions. At times, bills introduced by the Commissioners would be amended by members of the legislature to suit the wishes of their constituents in certain localities. The result was generally a jumble.

For a long time the struggle of the various Commissions for better and more effective laws met with little success. Not until 1901 did the legislature enact two measures, one for the State at large, and one for Lake Erie, which were almost exactly as introduced by the Fish Commission and Fish Protective Associations. These measures were the first laws which in any way approached the real needs for proper protection, but even these laws, while they apparently covered everything are capable of improvement and strengthening. They are ambiguous in places.

A second difficulty encountered was the violent resistance on the part of a large number of people throughout the State to the imposition of any fish laws. Nearly all the people wanted laws, but they desired them to apply to their neighbors rather than themselves. For instance, residents of the Susquehanna Valley said there ought to be laws against ice fishing, but no law against fish baskets and gigs. These people would go to the legislature to fight the bills introduced.

A third difficulty was presented by the element in the State who were ardently in favor of fish laws, but wanted them of so drastic a character as to make their passage not only unwise but practically impossible. These people were usually sportsmen anglers of the most radical type. This resulted in the development of a very bitter feeling between the whole army of anglers and the commercial fishermen. It is strange to say that for many years the angling element was the one which prevailed in the legislatures. It became almost impossible for a commercial fisherman to carry on his trade except in the Delaware and lower Susquehanna rivers. The commercial fisherman actually could only fish during the first six months of the year, excluding the fishermen in Lake Erie. Even they were so handicapped that they felt forced to do illegal fishing, notwithstanding their real objections to such practices.

The Commission that immediately preceded the Department of Fisheries, of which S. B. Stillwell, of Scranton; H. C. Demuth, of Lancaster; J. W. Correll, of Easton; W. E. Meehan, of Philadelphia; John Hamberger, of Erie; James A. Dale, of York, were members was the first to secure as liberal laws being enacted for the commercial fishermen as for the angler.

A fourth and very serious difficulty against which the Commissions had to contend was water pollution. This trouble instead of decreasing, has materially increased. Deposits of sawdust, one species of pollution, have decreased, but everything else has done just the opposite. This is due to the growth of cities and towns and consequently, industries. So far no legal method for stopping water pollution has been discovered. Tanneries, chemical works, factories, sulphur water from the mines, are all fruitful sources of the pollution that is sometimes so great as to destroy vegetable as well as fish life. Courts have upheld the sulphur water contention. In one instance, the Supreme Court said that when water could be made to run up hill, the sulphur water could be stopped and not before.

Still another difficulty was to be found in local magistrates and peace officers. Until quite recently there seemed to be a prevailing idea among justices of the peace and even some judges of county courts that violations of the fish laws were trivial offences. Constables neglected to attend to their duties as ex-officio fish wardens, fearing to engender an unpopularity that might militate against their re-election.

Dams built in streams prevented fish from going up and down the rivers. The difficulties encountered in abolishing this obstruction materially increased when the Supreme Court of Pennsylvania upheld the refusal of dam owners to pay for fishways where dams were erected before the passage of the act providing for fishways. It was not until 1901 that a way was found out of this difficulty, when the legislature provided for it by a section in the general fish act.

IMPROVEMENT OF THE SHAD FISHERIES.

The first efforts of the Commission appointed in 1873 were devoted to the improvement of the shad fisheries. After carefully studying the situation the Commissioners agreed that three principal causes were contributing to the decline of the shad fisheries. Briefly these causes were: First, fishing in the lower parts of the river with drift nets; second, an inadequate "close time," or the time fishing is forbidden in the rivers; third, the destruction by fish baskets of the young shad when returning to the sea.

To surmount these difficulties was no easy task. The Susquehanna was selected as the field on which to begin operations and fish baskets were the first point of attack. This was a perplexing problem for by some legal technicality in the construction of the law, the sheriff was obliged to give ten days' notice before removing a fish basket. This practically rendered the law inoperative

and the energies of the Commissioners were then directed to securing the repeal of that clause in the law. Subsequently the arguments of the Commissioners prevailed. The legislature eliminated the objectionable clause in the law, and fish baskets could be destroyed as soon as they were discovered.

Drift nets were also a subject for serious debate. While too many fish were captured by their use, it seemed impossible to forbid them entirely as they were an actual necessity in some localities. In some places shore fishing was impossible and consequently a drift or gilling net was necessary to make fishing possible. To overcome this difficulty a "close time" of sufficient length was recommended and the observance of it strictly enforced.

A strict observance of the "close time" was also vitally important in securing a sufficient annual supply of shad. Upon the ability of the shad to reach their spawning grounds, depends largely, the annual supply of fish. With a short "close time," together with the devices used to ensnare the fish, comparatively few reached the spawning grounds. The conclusion is obvious.

It soon became a self-evident fact, that artificial propagation was essential, if the shad fisheries were to be restored. The results obtained through this means were carefully studied by the Commissioners. What was accomplished by artificial propagation for the Connecticut river and other streams could surely be accomplished for the Susquehanna and Delaware rivers and Commissioners of Pennsylvania felt justified in introducing it.

A hatching box, invented and patented by Mr. Seth Green, the eminent fish culturist of Rochester, New York, was used with satisfactory results in other States. A correspondence was opened with Mr. Green, and arrangements were made by which Pennsylvania purchased the right to use his hatching boxes for three years.

A fishery at Newport, Perry county, was selected as a base of operation. An assistant of Mr. Green was placed in charge of the work and notwithstanding many obstacles, 2,700,000 young shad were hatched and planted in the Susquehanna river, at Newport, in 1873. Besides this 500,000 young shad also hatched under the auspices of the Pennsylvania Commission were placed in the same river at Columbia and Marietta the same year.

By an act of the legislature in 1879, the number of Commissioners were increased from three to six. John Hummell, of Selinsgrove; Robert Dalzel, of Pittsburg, and G. M. Miller, of Wilkes-Barre, were the new members appointed.

At this time there were to be found in the Susquehanna river in the dam at Columbia, two fishways. The first was the old company fishway, forty feet wide at its mouth and twenty feet at its head; the second, the State fishway, about fifty feet wide. In addition

to these, there were two old breaks in the dam, towards the York county shore. These openings were the only means by which shad could pass up the river, but owing to the persistence with which many fishermen casts their nets before them, in defiance of the law, the fish were frightened away and the number that passed was unsatisfactory.

This same legislature which increased the size of the Pennsylvania Commission of Fisheries, also authorized it to extend the experiment of fishways in the Columbia dam. Accordingly advertisements were inserted in the Harrisburg papers for plans and models. Several were submitted and tried, but none were accepted. Later, a modification of a plan submitted by a Mr. Whitney was tried. While large numbers of shad succeeded in passing up the river at times, the fishway was not a real success. Lawless fishermen also added to the difficulties of the experiment.

In vain also were the efforts of the Commissioners to secure the co-operation of the Maryland Commission in regard to a "close season." Several suggestions were offered by the Pennsylvania Commission which would have benefitted materially the shad fisheries of both States, but they were rejected by the Maryland Commission as impracticable at that time.

Mr. Howard J. Reeder retired from the Commission in 1881. Mr. Arthur Maginnis, of Swift Water, succeeded him, and the Hon. B. L. Hewitt became the president of the Commission. At this point the work of the Commission was greatly impeded through a lack of funds with which to carry on the work. The earnest efforts made to mete out justice to illegal fishermen also met with little success owing to the apathy shown by juries to convict the persons accused.

In 1883, an almost entirely new Commission was appointed. John Gay, of Greensburg, became the new president, and with him were associated H. H. Derr, of Wilkes-Barre; A. M. Spangler, of Philadelphia; Aug. Duncan, of Chambersburg; Charles Porter, of Corry, and Arthur Maginnis, of Swift Water, the only member of the old Commission retained.

Among the earliest laws passed was one providing that owners of dams should erect fishways therein in order that migratory fish might pass through these obstructions. Unfortunately the law did not stand the test of the Supreme Court, so far as dams existing at the passage of the act were concerned, it being in the nature of an *ex post facto* law.

The law was weak also in other particulars, rendering it difficult to compel the erection of fishways in dams built after the passage of the act. A good strong law, effective in every particular and in

accordance with the decisions of the Supreme Court, was not entered on the statute books until 1901.

The new Commissioners gave careful consideration to the introduction of a fishway which would prove successful. After a two years' search for such a fishway, their attention was drawn to the Rogers', "Ladder." This "Ladder" was invented in Nova Scotia and simplicity, durability, efficiency and comparative inexpensiveness were the merits claimed for it by its inventor, Mr. Rogers. Forty-three of them were used successfully in Nova Scotia and Mr. Rogers was strong in his belief that it could be used with the same success in the Susquehanna. So strong were his convictions on this point that he agreed to erect at his own expense a "Ladder" in the dam at Columbia and waived all claim to re-imbursement until the success of his invention was fully demonstrated.

A Rogers' "Ladder" was erected therefore and for a time was considered eminently successful. A warden who belonged to that district declared that the shad ascended this fishway very freely. His statement was accepted without investigation and several years elapsed before it was discovered that the warden spoke rather out of enthusiasm than from a careful and accurate knowledge of the facts. There is no doubt that a few shad did pass through the fishway, but the number was disappointingly small. The Commission became convinced that the fishways, while very efficient for most species of fishes, were not all that was required of them for shad, excepting where the dams did not exceed five feet in height and where the newness of the device had been obliterated by Algae.

It was found that the shad were exceedingly timid and hesitated to enter what seemed to them a trap. The shad went freely through the Rogers' "Ladder" in the Lackawanna dam in the upper Delaware river because there the structure quickly became discolored and the dam was only four one one-half feet high. Indeed, in high water shad could pass over the dam without the aid of a fishway.

Nor was this the only work accomplished by this Commission. Every effort was made to restore the shad fisheries to their original greatness. Eighteen fish baskets were destroyed in the Juniata river, and the Susquehanna was relieved of nearly two hundred of the same illegal devices.

Henry C. Ford, Philadelphia, president; H. C. Demuth, Lancaster, secretary; James L. Long, Pittsburg, corresponding secretary; W. L. Powell, Harrisburg, treasurer; S. B. Stillwell, Scranton, and A. S. Dickson, Meadville, associates, were the members of the next Pennsylvania Fish Commission.

This Commission began its labors under more auspicious circumstances than its predecessors. A fishway then thought to be satisfactory had been erected and vigorous warfare declared on fish

baskets. Realizing the futility of engaging extensively in the propagation of shad until the rivers were freed from destructive devices, the Commissioners resolved to devote their first energies to the accomplishment of this task. New York and New Jersey offered their hearty co-operation and the Delaware river was patrolled by vigilant wardens from the three States. As a result of their work, the Delaware river in 1888, was said to be free from fish baskets, traps and wiers. Nor was the Susquehanna neglected, but here the reward of "eternal vigilance" was not so great. This lack of complete success was not due to the policy pursued, but to the nature of the river itself. The Susquehanna is very wide. Its tributaries are many and of great length. It is filled with numerous islands and large rocks which form a safe shelter for illegal fishermen as well as for some of the devices.

Another great step in the work was accomplished when the Commissioners of Pennsylvania, New York and New Jersey formulated and adopted a uniform code of laws for the Delaware river and which was adopted finally by the legislatures of the several States. This code provided for a "close season" for shad and sturgeon; protection for a specified time for new species of food fish planted in the Upper Delaware, and protection also for the spawning ground of the shad.

All this work prepared the way for the great work of the Commissions in the artificial propagation of shad. During the first years, the steamer "Fish Hawk" belonging to the United States Commission was sent to Gloucester and under the auspices of the Pennsylvania Commission, many millions of shad eggs were hatched out and planted in the Delaware river and its tributaries. A resident of Gloucester erected a small hatchery on the banks of the river at the earnest solicitation of the Commissioners, and there the work of propagation was carried on by the United States Commission for the Pennsylvania Commission. Mr. John Gay, who afterwards became a member of the Commission, was in charge. The young fry were planted by the Pennsylvania Commissioners in the head waters of the Delaware. Although the work done was most successful, this small station was abandoned, for some unknown reason, by the United States Commission, after the second year.

In spite of the limited accommodations for the work, the success attained was marvellous, nor was this success confined in one locality. From the Upper Delaware to Trenton, and from Trenton as far south as Cape Henlopen, the fisheries became profitable. In 1873 \$81,000 represented their market value. In 1890, this sum grew to over a half-million.

Strange as it may appear, this increased commercial value of the shad fisheries instead of mollifying, actually frightened some fisher-

men. They were fearful lest the prices might decrease with the increased supply of the fish and render the fisheries less profitable. But their fear were groundless. Not only were the Eastern markets eager purchasers but the Western markets also clamored for shad and as the facilities of transportation permitted it, it is no unusual thing to see this sign: "Fresh Delaware River Shad," in the markets of Cleveland, Chicago and other Western cities.

THE ESTABLISHING OF HATCHERIES.

While much has been said of the shad fisheries we must not think that this is the only industry which claimed the attention of the Commission. The pike-perch, another exceedingly valuable food-fish, was causing the Commissioners much concern. Its rapid destruction, both in the Susquehanna River and Lake Erie was viewed with anxiety, yet at this time they seemed unable to do much towards restocking these waters and other waters of the Commonwealth. The United States Fish Commission, however, generously came to the rescue and in 1899, hatched about twelve million fry for the use of the Pennsylvania Commission.

The greater number of these fry was planted in the Susquehanna and the beautiful "Blue Juniata." A smaller number found a home in the upper waters of the Delaware and in the Schuylkill near Reading. The fish thrived in their new homes and grew rapidly, as is attested by the fact that one was caught at Dingman's Ferry weighing nine and three-fourths pounds, while fish weighing four and five pounds were caught annually, in large numbers, along the river as far south as Trenton.

During a raid on fish baskets in the Delaware river above Bushkill, in 1890, thirty-four pike-perch were taken from one of these devices near Port Jervis. To-day pike-perch or wall-eyed pike, known as Susquehanna salmon, is the predominating fish in Lake Erie and the Susquehanna river.

A new hatchery had been established at Erie and there in 1899, the Pennsylvania Fish Commission began the work of propagating pike-perch. During this year nearly nine million young fry were distributed and the following year this number was increased to 13,545,000. This increase was due largely to the discovery made by Mr. William Buller, the Superintendent, of a perfect method of cleaning the eggs. In 1891, 40,600,000 eggs were hatched out and planted. The enormity of this number may be realized when we learn that it is within 3,000,000 of the number of young shad planted in the Delaware and Susquehanna rivers between the years 1889 and 1891.

Recognizing the great value, financially, of this industry, the Com-

missioners made still greater efforts to increase it and in 1892, 59,000,000 of this species of fish were planted, mostly in Lake Erie, the great center commercially, for the pike-perch. The upper Delaware, the Susquehanna and their tributaries, also received vast quantities of the same fish nor were the large lakes of Pike and Wayne counties forgotten.

Meanwhile as constant reference must be made to the fish cultural work done by the various Pennsylvania Commissions at their several hatcheries, it may be well to pause here and give some little account of the establishment of these stations.

The existence of a Pennsylvania Fish Commission necessitated also the existence of a hatchery where the work of fish culture could be carried on. One of the first works, therefore, of the Commission appointed in 1873, was to find a desirable site for a hatchery and erect thereon a suitable building. In selecting this site two important facts had to be considered; first, that the water supply was of sufficient quantity and quality; second, that the station was within easy access to the railroads.

Many were the places visited and many the inquiries made regarding water, transportation and other points of advantage of the various sites. A beautiful spot in Lancaster county, about two miles from Marietta and located on the banks of the Donegal creek, met with the favor of the Commissioners. Hoover spring, one of the group of the famous Donegal springs, would furnish the water supply. This water bubbled from a limestone bed, was cold, clear as crystal, and had a capacity of about 3,000,000 gallons a day. Mr. Michael Hoover owned the property and from him, in the autumn of 1873, the Commission purchased one acre of ground and also the right to use from his spring, all the water necessary for the operation of the hatchery. The sum of \$2,000 was paid for this property.

Bids were then advertised for the erection of a hatchery house. B. F. Hiestand agreed to build the house, equip it with the necessary fixtures and plumbing, for the sum of \$3,700.

The new house, when completed, measured one hundred feet in length by thirty-two in width. It was supplied with seventeen hatching troughs, eighteen feet long and fourteen inches wide. The water to supply them was piped from the spring to the house, and fed to each trough by iron spiggots attached at regular intervals to a supply trough which extended the whole length of the house. When the building was completed it was called the Marietta Hatchery.

With two of the most important considerations fulfilled, another of equal importance was claiming the attention of the Commis

sioners, namely, the selection of a suitable superintendent for the stations. Mr. Howard J. Reeder thought he knew the right man for the place. His name was John C. Creveling. On Mr. Reeder's recommendation he was appointed the superintendent of the Marietta Hatchery. That Mr. Creveling fully justified the confidence placed in him is proven beyond question by the fact that his services have been retained by every successive Commission to the present time, and that he has always had charge of one of the most important hatcheries. Mr. Creveling's last assignment was to the new Bellefonte Hatchery at Pleasant Gap, Centre county, which when completed and fully equipped will be one of the largest hatcheries in the world.

Mr. Creveling is a modest man, hence we do not know a great deal of his personal history. Born in New Jersey in a place called Bethlehem, he spent his early life on his father's farm. The Crevelings had for a neighbor "Thad Norris," a famous angler and fish culturist in that locality. Mr. Norris became very fond of the boy, Creveling, and possessing a generous, sympathetic and genial nature, he taught the boy the subjects which he, himself, loved. Mr. Norris afterwards took up as a business the work of fish culture and employed as a helper, the young lad Creveling.

Here, at Troutdale, New Jersey, Mr. Creveling began the real study and art of what has proved to be his life work. When Mr. Norris finally sold his establishment to one of the fish commissioners of New Jersey, Dr. J. H. Slack, a condition of the sale was that Mr. Creveling's employment should not cease. Mr. Creveling rapidly became an expert fish culturist and four years later his services were secured by the Pennsylvania Commissioners. Mr. Creveling has been the instructor of every superintendent employed by the Pennsylvania Commissions.

With the completion of the hatchery at Marietta began the operation of hatching eggs. The United States Fish Commission sent to Pennsylvania 150,000 eggs of the California trout, but owing to heat and exposure during transportation when received at the hatchery only one thousand fish were hatched out of this number. These were planted in a tributary of the Susquehanna river.

Near Rochester, New York, Mr. Seth Green operated a hatchery of the New York Commission. From him were purchased 100,000 eggs of the salmon trout. Mr. Creveling personally superintended the transportation of these eggs, with the result that there was little or no loss. A very large percentage of the eggs was successfully propagated and planted in the waters of the western part of Pennsylvania in due time.

While the Commissioners at this time deemed it necessary to devote their main energies to increasing the supply of black bass,

shad, and other food fishes, in the rivers, yet they did not forget to make provision for beginning the culture of brook trout, leaving the greater development of this work to successive Commissions.

Trout ponds were built on the hatchery grounds at Marietta and through the generosity of Colonel Duffy were supplied with spawn. Col. Duffy, one of the members of the Commission, lived at Marietta and had ponds of his own on his place. His love of the art, and his desire to strengthen, increase, and broaden the work of the Fish Commissions together with his natural whole-souled generosity, led him to place at their disposal the use of his own trout. So long as the hatchery remained at Marietta his trout were stripped, annually, of their eggs for the use of the Commonwealth. From them was derived the greater part of the finest stock now at the several hatcheries.

At first something less than one hundred thousand trout fry were obtained. From this modest beginning, in 1891, 2,508,000 fry were produced from the two trout hatcheries. By the beginning of the twentieth century this number increased to 3,500,000 and this year, since the advent of the Department of Fisheries over 6,000,000 fry is the output from the trout hatcheries of the Commonwealth.

THE WESTERN HATCHERY.

It did not take long for the work at Marietta to assume such magnitude as to overtax, seriously, the resources of the hatchery. As a result, the Commissioners decided that a new hatchery was a necessity. Accordingly, in 1875, they set about finding a suitable place. They decided upon a site at Corry, a town in northwestern Pennsylvania, forty miles from the city of Erie. One only has to visit Corry to convince himself, beyond a doubt, of the wisdom of the Commissioners in selecting this site.

The tract of land purchased by the Commissioners for \$2,000, and comprising about nine acres, was about two miles distant from the centre of Corry. The tract, oblong in shape, was divided into two parts by Smith street, a thoroughfare of Corry. The whole place somewhat resembled a primeval forest, so thickly was it covered with trees, vines and underbrush. Although springs of deliciously cold water and the streams which ran from them, dotted the land, yet the inclination of the surface prevented dampness and excessive moisture. The streams flow over a heavy, dark, blue soil and though they are clear and sparkling, reflect so intensely the coloring of the soil, that they, too, appear dark.

A very comfortable dwelling house and a substantial though very old barn were also on the grounds. The place was owned and occupied by a Mr. Seth Weeks, who conducted a small hatchery for

brook trout, on his own account. He agreed to sell it to the Commission. Besides the \$2,000 appropriated by the Legislature for its purchase, there were also \$3,000 for its improvement. With this money the Commissioners had erected and equipped a first class hatchery, had ponds dug and other necessary improvements made. A fine hatchery house, sixty feet long by thirty feet wide, was built. It was equipped with troughs of the newest and most approved pattern of that time, arranged so as to facilitate and render less wearisome, the work of the men.

When completed it was called the Western Hatchery because of its location in the State. Mr. Weeks, the former owner, was appointed its first superintendent. Under his management there were hatched and distributed the first year, 154,000 brook trout and 185,000 salmon trout, besides being planted in the ponds 3,000 mature brook trout and 250 salmon trout for breeding purposes.

Shortly after this Mr. Weeks resigned as superintendent and Mr. William Buller was offered the position, he then being assistant to Mr. Creveling at the Eastern or Allentown Hatchery.

Mr. Buller was born in Maytown, Lancaster county. Like Mr. Creveling, he early developed a love for fish work. Mr. Buller assisted in building the hatchery near Marietta and when it was completed was regularly employed by Mr. Creveling to assist him in his work. The complete and skillful instruction given by Mr. Creveling, combined with the faithfulness, untiring energy, quick and keen intelligence of Mr. Buller, well fitted him for the position of superintendent of the new station. The Commissioners, especially Colonel Gay, who had been closely watching his work, were quick to note his worth and while Mr. Buller's innate modesty would have made him refuse their offer, they insisted on his acceptance, appreciating the ability he, himself, failed to recognize.

Colonel Gay and Mr. Buller set out for Corry, bent upon improving the hatchery and its surroundings. To hearts less stout and minds less keen in their appreciation of the beautiful, the task might have seemed hopeless; but their energy knew no tiring and their ambition no curb. The place was already beautiful with that wild, picturesque beauty, but it needed "laying out," so that it could be used, enjoyed, and fully appreciated, and above all else, so that its mission in fish cultural work could be fulfilled to the greatest possible extent.

Fallen trunks of trees, stumps, underbrush, unnecessary vines, superfluous growth of all varieties, were cleared away. Picturesque walks and drives were laid out, rustic bridges built across streams and ravines, several fountains erected, and an artistic summer pavilion built, enclosing a spring. Add to this on a summer's day, domes of deepest azure, birds singing and twittering among the

trees, timid deer amid the foliage, beautiful speckled trout darting around the ponds, and two magnificent St. Bernards scampering everywhere.

Mr. Buller has transformed the place into a park of exquisite beauty that not only delights the people of Corry but attracts visitors from all over the State.

But this was not all. The hatching house was lengthened from sixty to one hundred and ten feet and the number of troughs increased to eighty-eight, forty-four on either side. These troughs are twelve feet long, eighteen inches wide and seven inches deep and have a capacity for 20,000 freshly hatched trout each. Of course after a couple of months when the little fish have become materially larger, the number in each trough must be reduced to 15,000.

Another improvement of great value has been contrived by Mr. Buller for this station. Formerly, all the meat used for feeding the fish had to be chopped by hand, but now this is done by machinery. In a corner of the grounds, Mr. Buller has erected a water wheel and a meat house and in this is prepared all the meat used for the fish, at a very great saving of both time and labor.

The popular demand for fish for restocking purposes, becomes greater and greater as the work of the Fish Commission becomes better known. This demand necessitated further facilities for hatching trout. Consequently in 1897, a second building, fifty feet long, and twenty-feet wide was erected to the right of the original building with a capacity of a million fry. Even that soon proved inadequate and it was considered necessary to extend the area of the property in order to build a third hatching house and to accommodate more ponds for breeding fish.

In 1901, seven acres of additional land were purchased on the left of the original tract. This tract contained more than half a dozen springs and a portion of it was heavily covered with noble timber. Here was erected in 1902, a hatching house 124 feet long and 20 feet wide, with a capacity of over two million trout fry, making a total capacity for the Western Hatchery of over 5,000,000. Half a dozen large trout ponds were constructed and three large ponds for the cultivation of black bass. In addition, a large nursery pond was constructed on each side of the new hatchery for newly hatched fish and fitted up with automatic food feeders.

At first the cry was for shad, white fish, pike-perch and other food fish, of great commercial value; but later, great numbers of trout fry were requested. Through water pollution and illegal fishing the trout streams had become greatly depleted and farmers, as well as anglers, awoke to the necessity of restocking them. So notwithstanding the increased facilities the demand continued to be greater than the supply.

Should one visit the Western Hatchery you would find over forty ponds for breeding purposes. In these are found large lake trout, hybrid trout, brook trout, California trout, and brown trout, all of large size. The yellow perch, known around Philadelphia as "yellow neds," and black bass are also to be found here. It may be interesting to note here, that the brown trout was introduced into the United States from Germany for the first time in February, 1883, by a man named Von Behr.

This hatchery is supposed to be used exclusively for the various kinds of trout only, but at different times it has been used for other fish also. For instance, last fall several million eggs of the white fish were hatched here and afterwards transferred to the hatchery at Erie. This year Mr. Buller intends to hatch a number of pike-perch eggs at Corry and so relieve the over-crowded Erie Station, if necessity arises.

THE EASTERN HATCHERY.

The water supply at the hatchery near Marietta had been causing the Pennsylvania Fish Commission much trouble for some time. Although the water was cold and clear as crystal there was not always a sufficient quantity to operate the hatchery satisfactorily. Should there be a long continued rainy spell the supply was ample, but when the weather was clear and dry the supply was insufficient. This was a serious embarrassment to the work of the hatchery.

To overcome this, the Commissioners decided to secure a new site where the supply of water would be ample, beyond question, in all seasons. An advertisement was accordingly published in various papers and in response to it a letter was received by Mr. Hewitt of the Commission, from Mr. William Lewis, of Allentown, recommending Mr. Troxell's property as a suitable site.

In answer to the letter of Mr. Lewis, Mr. Hewitt and Mr. Creveling visited the property recommended. They found it delightfully situated on the banks of the Little Lehigh river, about four miles from Allentown. Railroads reaching to nearly every part of the Commonwealth were easily accessible. It was a picturesque spot. The land swept, in almost imperceptible undulations, for a distance of several hundred yards to the base of a steep hill which protected the property from heavy winds. On this ground was an immense spring of the clearest, coldest water. It bubbled from the earth with such force as to throw gravel and pebbles into the air to some height and it discharged daily, more water than could possibly be required for use by the Commission.

Mr. Reuben Troxell owned the property and on it conducted a small, private hatching house of his own. It was very small, the

little old building containing only four troughs for hatching purposes, while on the grounds were one or two small ponds for mature trout.

The place was just the kind of spot for which the Commission of Fisheries was seeking. They at once entered into negotiations with the owner for securing the property. The place was not for sale then, but Mr. Troxell finally agreed to the following terms: The property, including the trout in the ponds, was leased to the Commonwealth for a term of five years for \$225 per year, with the opportunity to purchase the property at the end of that period. After five years the annual rental was to be \$300, with the option of purchase at the end of ten years.

On January 1, 1883, the lease was signed and the Commission was relieved of the Marietta property by the Honorable Simon Cameron, who purchased it from them for the original price paid for it.

Then began preparations for the removal of the Marietta Hatchery to the Eastern Station near Allentown. This was no easy task, for in its nine years of residence at Marietta, vast quantities of fish had accumulated besides the various fixtures and apparatus. Mr. Creveling, the superintendent, directed the work of removal and to his skill and care and the great assistance and courtesy extended by Mr. Wilson, Superintendent of the Reading and Columbia branch of the Reading Railroad, is due the fact that not a single fish was lost in transportation.

Mr. Creveling and Mr. Buller his assistant, found much to do before the new station could be operated successfully. The grounds were in bad shape, the buildings running down, ponds had to be excavated, a new hatchery built, troughs and other appliances put in place, and all this to be done before the spawning season began. They accomplished it however, for hard work and difficulties daunted neither of these men, and by September first everything was in readiness for the season of active work.

The new building contained thirty-four troughs, sixteen feet long and eighteen inches wide and accommodated about half a million fry until they were four months old, when they were placed in ponds. The troughs are colored black with white graveled bottoms and are, indeed, a most interesting sight when filled with spawn and later, the tiny fish.

The trout ponds have sodded borders and are reached by means of graveled walks. Beautiful willow and other trees, flower beds, the sparkling streams, the distant hills, all combine to make the spot charmingly picturesque. Its loveliness was enjoyed not only by the people of Allentown, but visitors from Bethlehem and other cities and towns in the eastern part of the State, who were at-

tracted not only by the beauty of the country but the ever increasing interest in the fish cultural work of the Commonwealth.

On the establishment of the Eastern Station it was determined, for several reasons, to devote its resources to the propagation of brook trout exclusively but great numbers of other fish have been hatched here. Among them may be named the California trout, the Atlantic salmon, and the German carp. Comparatively speaking the German carp was not a success for hatching purposes, because of the superlative coldness of the water.

Large numbers of fish were incubated and distributed annually at this station and the numbers were rapidly increasing. Success has ever been the keynote of the work done. Only on two or three occasions did misfortune visit the hatchery. The number of fry grew speedily but the accommodations remained the same. In 1888, the numbers were so large that the brook trout fry were stricken with disease which resulted in the destruction of over 400,000 fry. Investigation proved that meagre accommodation was largely responsible for the disaster.

In February, 1899, while the troughs were overcrowded with fry there came a great blizzard and from its effects the entire hatching for the year nearly 2,000,000 fry were destroyed. In 1902, a great flood swept over the property, carrying with it 12,000 breeding fish and three-quarters of a million fry.

The Pennsylvania Fish Commission thereupon petitioned the Legislature for relief. The great destruction of fish life caused by insufficient accommodations was a strong and potent argument in favor of the Commission's request for an additional hatching house. The argument prevailed and the result was another building at Allentown which doubled the capacity of the old building.

As the Commonwealth never acquired ownership of the property on which the Eastern Station was located, the Commission was always very cautious in its expenditures for improvement. It felt that it would be unwise to expend money on permanent improvements under the existing conditions. Hence this really lovely spot was never developed to its fullest possibilities. The reasons for its final abandonment will be related in due time.

THE ERIE HATCHERY.

Realizing the great commercial value of the white fish industry in Lake Erie, and aroused by the efforts and work actually being done by other States bordering on the Great Lakes, the Board of Trade and the Select and Common Councils of the city of Erie determined to stimulate similar action on the part of their own Commonwealth.

Accordingly, in 1877, an invitation was extended to the Pennsyl-

vania Commission of Fisheries and a special committee of the State Legislature to visit Erie, and in company with the Board of Trade, Select and Common Councils make an investigation of the fish industries in operation in that section of the country.

At this time Michigan, Wisconsin, Ohio, and other States bordering on the Great Lakes were not only interested in the great commercial value of the culture of white fish, but were also appropriating yearly, generous sums for its artificial propagation. Michigan and Wisconsin had already hatched 18,000,000 fry, and Ohio was operating four stations, experimentally. The people of Erie wanted to convince the State officials of the necessity and desirability of establishing a hatchery in this section, so that Pennsylvania might not only do her part in common with her sister States, but also reap a portion of the benefits.

While nothing definite was accomplished on this first visit it was portentous of good. The Commissioners did much thinking and in October, 1884, decided upon a second visit. Four members of the Commission went to Erie to consult with the citizens about the establishment of a hatchery for white fish in their city. A warm welcome was accorded them and a meeting called so that plans might be discussed.

Ways and means and many plans were considered. At first a temporary hatchery was suggested, the Commission to pay one-half the expenses and the citizens to defray the other half. After considering the pros and cons in regard to the cost, the lateness of the season, the small amount of funds in the hands of the Commission, etc., it was deemed inadvisable to begin the work at that time.

Further consideration evolved a wiser plan. It was finally decided to ask the legislature for an appropriation of \$5,000 with which to erect a hatchery. This sum would secure a lot, a suitable building and the necessary equipment. The city of Erie promised to furnish the water supply free of cost. When, subsequently, the station was established the agreement was kept for a period of two years only when it was repudiated and an annual charge of \$400 made. This sum was still required up to the close of 1903.

The legislature, understanding the need for Pennsylvania to emulate the work done by her sister states, appropriated \$5,000 in 1885, with which to establish a hatchery in Erie for the propagation of lake fish.

Immediately a search was instituted for a suitable lot. This was found on the corner of Sassafras and Second streets, Erie. For the sum of \$900, a piece of ground fronting eighty-two and one-half feet on both streets was purchased, and for \$1,521.70 a commodious hatchery erected thereon.

The Erie Station, which was designed by a professional architect,

is a very attractive building. It is fashioned like an artistic residence, such as might be built for a family of more than comfortable means. It is a frame building irregular in design and height, with peaked roofs and gables and porches, and is surrounded by grounds attractively laid out.

Inside the building everything is arranged to conserve to the best interests of the industry to be developed there. In the hatching room on the first floor were the tables upon which were arranged the automatic jars of the McDonald pattern, each jar having a capacity for 150,000 eggs.

A large, well-lighted office for the superintendent adjoins this room. The sleeping apartments for the employes are on the second floor. These are daintily furnished. A tank room, containing a tank with a capacity of 1,200 gallons, is also on this floor. From this tank, at an even pressure, water is supplied to the jars on the first floor, although if need be, water could be supplied direct from the city mains.

Both from a standpoint of beauty and perfection in equipment, the Erie Hatchery is one of the finest in the country, and the amount of work accomplished there, almost incredible. The station was first operated on December 12, 1885. From that date until January 9, 1886, 16,000,000 white fish eggs were received. From March 17 to March 31 of the same year, 14,625,000 young white fish were planted in the lake outside of the city of Erie.

Mr. William Buller, Superintendent of the Western Hatchery at Corry, was also in charge of the Erie Station. The following figures attest to the efficiency of his management: In five years, beginning March, 1886, 64,820,000 fry were hatched at this station and distributed.

The splendid work done by Pennsylvania, Ohio and Michigan caused a revolution in the commercial value of the fishing industries of Lake Erie. In 1886, the catch of 61,500 pounds valued at \$175,200, leaped in 1888 to 2,200,000 pounds with a money value of \$304,680. In 1892, a half million dollars would not cover the value of the catch.

The same necessity for expansion that appeared at the trout hatcheries soon became apparent at Erie. The 120 jars, which were accommodated on the tables, became totally insufficient to supply the needs of the Lake. Hence about 1900, one of the tables was removed and a battery substituted, known as the Alpena System. This battery accommodated 270 jars. Even this soon became insufficient and in 1902, a second battery of the same size was installed, giving the house a capacity of 540 jars. The same year, 1902, the demand for yellow perch became so great that a number of small

ponds were constructed in the lawn surrounding the hatchery. The first year 2,976,000 yellow perch were hatched in these ponds.

The work at the Erie Station is not confined to the incubation of white fish alone. The pike-perch is also propagated in vast numbers. Owing to the rapidity with which pike-perch eggs are hatched, great numbers of them are deposited annually, not only in Lake Erie, but in other waters. The Delaware, Susquehanna and Juniata rivers, Spruce and Warden's creeks, and other important lakes and streams are fed with this species of fish. In 1891, 40,600,000 pike-perch were hatched and distributed in these several waters.

THE FISH INDUSTRY OF LAKE ERIE.

The following account of the fish industry of Lake Erie, taken from the report of the Pennsylvania State Commission of Fisheries for the year 1902, will be of much interest to the reader.

"The present condition of the fish industry of Lake Erie affords a striking illustration of the immense value of artificial propagation and of the practical usefulness of fish commissioners. Few, excepting those actually engaged or concerned, have any idea of the importance of the fisheries of our great lakes, and of the vast sums invested as capital in the industry.

"Every year the capital is expanding, every year the number of those engaged in fishing is increasing, and every year the value of the catch is swelling. Twenty years ago the money invested in the fisheries of Lake Erie amounted to about \$1,000,00, and about 1,000 men were employed in catching or handling fish. There was one large company at Erie, now sometimes termed the "fish trust," and one or two smaller concerns. To-day there are nearly \$2,000,000 capital invested, close upon 2,000 men employed and at Erie six large flourishing concerns that handle the fish caught within twenty miles of Presque Isle Bay.

"The first figures given indicate an important industry, the second suggest magnitude and something more significant, namely, a marked increase in fish life. A closer insight into conditions reveals the fact the suggestions are agreeable and astounding facts.

"Further figures and data disclose conditions that would be scarcely believable only for the ease with which they may be obtained. Pennsylvania has only a little more than forty miles of shore line on Lake Erie, and its fisheries are not as large as those of Ohio, or perhaps those of Canada, and it is doubtful if they exceed those of New York, on the same body of water; yet, some of the statistics of the fisheries at the city of Erie approach the marvelous.

"The bulk of the fish are caught in pound and gill nets, and the fishermen at Erie use 800 miles of gill nets alone in the pursuit of

their calling. One-half this great length of twine is used every day, the other half rests on the reels on shore to dry. That is to say, when the fishermen go to the fishing beds in the morning they take with them in gill nets, for use within twenty miles of Presque Isle Bay, which in the aggregate would, placed end on end, make two parallel lines for the whole length of Lake Erie.

"If, to these nets were added the equal length of gills drying on the reels on shore, for the next day's fishing, the whole would extend from Erie to Philadelphia and New York and almost back again. Or, if laid out in a straight line, would reach from Chicago to within fifty miles of Baltimore.

"Seventy-two steam tugs go puffing and snorting from the Erie fish wharves every morning to the fishing grounds, and they are preceded or followed by at least ten white sailed boats, and the owners of these boats pay to the State Fish Commission in the aggregate nearly \$2,000 in license fees every year for the privilege of fishing. All the boats are owned ostensibly by residents of Erie, although in reality some are probably owned or controlled by parties living in Ohio or other foreign waters. The boats, however, are registered under the names of Erie residents in conformity with an act of the Pennsylvania Legislature signed by the Governor, May 29, 1901.

"Each boat on departing from Erie for the fishing grounds carries about five miles of gill nets and each boat is manned with from four to five men. In the busy season, and on favorable days, each boat will return with from six to eight tons of fish, and on unfavorable days, with from two to three tons.

"In addition to the eighty-two tugs and sail boats which leave Erie every morning, there are a number of others from points in the vicinity that operate on or near the Erie fishing grounds.

"The value of the annual catch brought to the Erie docks every year is from \$600,000 to \$800,000, and it would undoubtedly be much greater if the boats could use their nets uninterruptedly. Unfortunately for the fishermen, conditions are not always favorable. Indeed it is often impossible to fish at all owing to the peculiar character of Lake Erie. * * *

"In view of these facts, it is indicative of a wealth of fish life that the Erie fleet is enabled to make an annual catch valued at from \$600,000 to \$800,000."

OTHER WORK.

Although the greatest efforts made by the earlier Commissions were directed to the work of restoring the shad fisheries in the Delaware and Susquehanna rivers, establishing the white fish industry

at Lake Erie, increasing the pike-perch in the various waters, and introducing black bass wherever it was found to thrive, yet they did not forget the trout streams of the Commonwealth. At first the work of the Commissions was comparatively unknown, hence unappreciated, and the demands for trout fry naturally were few. However, it did not take long for the good work done by the Commissioners, often in the face of great difficulties, to become generally known and with this knowledge came increased applications for this favorite game fish.

At first the output was small, but it steadily grew. From 154,000 in 1877, and this was considered enormous, the number in 1891 reached 2,508,000. It is interesting to note further that the Commission could not find enough applicants to take the first year's hatching, but within four years it was impossible to supply the demand. Even the vast stock on hand at the end of 1903 was nearly a million short of the demand made upon the hatcheries.

As a result of artificial propagation, streams that had become almost barren now yield rich returns. At a trifling cost to the Commonwealth between fifty and sixty millions of brook trout fry were hatched and planted in the mountain streams from the inauguration of the hatcheries to 1904.

Once upon a time it was thought that the Delaware river was a salmon river. Whether this belief was a species of fairy tale or not, the popular opinion prevailed that the Delaware river was a suitable abode for this splendid game and food fish.

The basis for this opinion was that the river possessed all the characteristics of a salmon stream, above Trenton Falls. Moderately cool temperature of the water, long stretches of rocky pools ten to twelve feet deep, fine reaches of froth beaten rifts, such as the lordly fish delight in, numerous large, cold mountain streams tributary to the river in which the salmon could deposit their spawn, and the smolts could pass the first year of their lives, were all characteristics of the noble Delaware.

Several gentlemen interested in fish culture decided to make an experiment. From Mr. Wilmot, of New Castle, Canada, who had charge of the British Dominion Hatchery, were purchased 10,000 salmon eggs. These were hatched successfully by Mr. Christie, of New York State, an adept in the work. On Memorial Day they were shipped to Easton, but although great care was taken in the transportation, a large number of them died and the survivors were very weak. These were planted in the Bushkill at Easton, a tributary of the Delaware. This was in 1871.

The next year a larger purchase of the same kind of eggs was made. To prevent mishaps Mr. Thaddens Norris hatched these eggs under his personal supervision. He deposited them in rude

hatching boxes and placed them in a spring near Easton. Eleven thousand out of thirteen thousand eggs were hatched and planted in a tributary of the Delaware river.

The efforts of these private citizens prompted Professor Baird, of the United States Commission, to give the Commonwealth of Pennsylvania 40,000 salmon spawn. He gave the same number to the State of New Jersey. These were incubated by Mr. Norris at Easton on the Pennsylvania side, and Dr. Slack at Troutdale, on the New Jersey side, and all deposited in a tributary of the Delaware.

Simultaneously, efforts were being made to stock the Susquehanna river with California salmon. A present of six thousand of this specie of fish was planted in the river near Harrisburg. Later twenty thousand more were deposited in various tributaries of the Susquehanna.

Naturally these efforts aroused general curiosity as to the results. For several succeeding years catches were made of a number of large salmon in the Delaware river, but they ceased soon after 1879. All the plantings in the Susquehanna were absolute failures. In 1884 the Fish Commissioners declared that the experiment was a failure and stated that "it would be a waste of money and time to repeat it."

This conclusion did not daunt the next Commission, however. Watching the results obtained by the New York Commission with the same fish, they believed the Delaware river ought to be as suitable home as the Hudson for the lordly salmon. Accordingly they procured from the United States Commission 100,000 eggs of the Penobscot salmon and sent them to Allentown to be hatched. The young fry were vigorous and strong. They were planted in the tributaries of the upper Delaware in Wayne county.

In 1891, two years later, 300,000 more eggs were secured, sent to Corry and Allentown for propagation, and planted in the same streams. From the results obtained it was proved conclusively that it is entirely feasible to make a great salmon river out of the Delaware, provided there be persistent planting in large numbers annually. In 1895 the survivors of the fish planted in 1890 returned to the river. Nearly one hundred were reported caught. The following year salmon to the value of \$5,000 were captured in nets. Afterwards, until 1902, there was a fair catch annually. Since then very few have been reported, owing first, to improper planting of fry, and second, to the Commission being unable to secure eggs.

Various experiments were tried with other fishes not indigenous to Pennsylvania waters. An attempt was made to introduce the grayling, but was unsuccessful for two reasons; first, because of the difficulty of rearing the fry; second, it seemed unable to defend itself against the attacks of its neighbors in new waters.

In the early seventies attention was also given to the salmon trout or lake trout. It is a toothsome fish of lordly proportions and its fine qualities both as a game and food fish made it a desirable acquisition to the finny tribe of Pennsylvania. The first attempts made to find it a new home were futile, but when, at last, the Commissioners selected the deeper mountain lakes for its new abode, success crowned their efforts and the salmon or lake trout became a Pennsylvanian by "naturalization."

For a number of years lake trout were bred from eggs taken from fish retained in breeding ponds, but it was found so expensive to feed the mature lake trout that in 1896 the propagation of this fish was abandoned. In 1902, through an arrangement with the United States Fish Commission the work was resumed at the Corry Station, the eggs, 2,000,000 in number, coming from the hatchery of the National Government on Lake Michigan. Last year, in addition to the supply from that source, the Pennsylvania Commission began the taking of eggs itself from wild fish captured on the fishing grounds off Dunkirk, New York.

On the other hand phenomenal success was achieved by the Commissioners in stocking the waters of the Commonwealth with black bass. Rivers, lakes and streams became their home. This success encouraged the Commissioners to introduce other "relations" of the same family, and in due season rock bass, grass bass, yellow and white bass, blue sunfish, and other numbers of the perch family have been introduced with different degrees of success in our rivers, streams and lakes.

For those who like fish simply as a food and are not over sensitive as to the extreme delicacy of their flavor, the introduction of the German carp must have given intense satisfaction. To satisfy a demand for this specie of fish the Commissioners early obtained fry of three varieties. They distributed the greater number among farmers, who in turn planted them in the streams. The carp grew and multiplied and have continued to grow and multiply so that the waters of the State are full of them.

1892, 1893, 1894 SHAD.

So far the work done by the various Commissions from their inception in 1870 until 1891 inclusive, has been related in a somewhat general fashion. The scope of the work of the Pennsylvania Commission of Fisheries being definitely established and planned, the interested reader will probably enjoy more fully an account of what has been done to the present time, under specific heads.

That the Commissioners consider the commercial interests of the Commonwealth of paramount importance is demonstrated by a com-

parison of the annual output of food and commercial fish with that of game fish. At this time (1892-94) the yearly distribution of game fish numbers about four millions, while the number of food and commercial fish averages from sixty to seventy millions. Yet the interests of the anglers are dear to the hearts of the Commissioners also, and to this element they are indebted for most efficient help and strongest sympathy in their work.

One of the great sources of revenue to the Commonwealth in this Department is the shad industry of the Delaware river. The one time lucrative shad fisheries of the Susquehanna river have been practically ruined for want of proper protection, and the toleration of illegal devices in its course through Maryland, and often in Pennsylvania. The Susquehanna is a wide river full of islands and masses of rock which afford ample shelter to the fishermen who ply their trade in a nefarious way.

Owing to the fact that the warden service has been restricted because of limited funds, the Commissioners were not able to safeguard the river as they strongly desired to do. Pennsylvania, herself, could not give all the protection necessary. Steps must be taken by the Maryland legislature for the abolition of fish baskets. Despite the fact that the Honorable James Sudler, of the Maryland Fish Commission, in the early nineties, petitioned his legislature for its co-operation, nothing was done by that body. As a consequence both Maryland and Pennsylvania, especially the latter, were deprived annually of a large amount of legitimate revenue.

Recently Mr. Oregon N. Dennis, of Baltimore, secretary of the Maryland Game and Fish Protective Association, revived the work undertaken by Mr. Sudler and with better success. Two years ago he succeeded in inducing the legislature of Maryland to make a beginning in fish protective laws on the upper Chesapeake and the Susquehanna within the Commonwealth of Maryland. He is now endeavoring to have these statutes improved on the lines of the Pennsylvania laws.

Twenty-five years ago the yearly catch of shad in the Susquehanna exceeded that in the Delaware and by some persons were thought to be superior in flavor. Now little is heard of Susquehanna shad, except along the Susquehanna Valley and in Baltimore, and until pound, buck and other fixed nets are removed or regulated in Chesapeake Bay, and fish baskets in the Susquehanna are subjected to the same treatment, can there be any possibility of restoring the Susquehanna river to its former eminence.

According to statistics \$650,000 represents the value of the shad fisheries in the Delaware river and bay in 1892. Comparison with the value of the aggregate catch in Virginia and North Carolina gives the Delaware river the lead by many thousands of dollars,

This is conclusive proof of the value of artificial stocking and of laws which prevent the destruction, by illegal devices, of the young fish in the upper river.

The results of artificial propagation and planting cannot always be seen immediately nor can the annual returns always be used as gauges of success.

Shad are salt water fish but they come into fresh water to spawn. The time of their coming is determined by several conditions. A late, cold spring retards the coming of the fish. They remain in the warmer tide-water instead of ascending the river. When the temperature remains low snow-water freshets are the order of the day, the ripe fish do not ascend the river in such large numbers. Again they prefer the tide-water. When the atmosphere and water are warmer, the fish not only ripen earlier but ascend the river in large numbers, and a great amount of spawn is deposited naturally as well as artificially.

Another cause for the predominance of the Delaware river over the other coast rivers is the watchful care over its interests exercised by Pennsylvania, New York and New Jersey. New York and Pennsylvania have always opposed the construction of dams above tide-water, hence the fish have the unobstructed run of the river for over two hundred miles. Other coast rivers from Maine to North Carolina are obstructed by dams close to tide-water. These dams are built for various purposes, such as, feeding canals and furnishing power to factories.

THE BRISTOL STATION.

Up to this time the propagation of shad was carried on exclusively by the United States Fish Commission. The steamer, Fish Hawk, belonging to the United States, was sent annually to Gloucester, a few miles below Philadelphia, and on board this vessel the work of hatching the shad eggs was carried on. When the young fish were ready for distribution and planting this work was done jointly by the United States and Pennsylvania Commissions. Under their direction the young fry were carried to Jersey City and from there sent by railroad to the Delaware Water Gap and the Upper Delaware river in Wayne and Pike counties for planting.

But Pennsylvania was anxious to possess a station of her own on the Delaware river for the propagation of shad. The Legislature of 1893 made an appropriation for the erection and equipment of such a hatchery. At first, an experimental station was proposed at New Hope, twelve miles from Trenton, but owing to the low temperature of the water and a number of freshets which deterred the ripe shad from ascending the river, the results were not satisfactory. This was in the spring of 1894.

Accordingly the Commissioners decided to erect a hatchery near Philadelphia, where the larger fisheries are more accessible and where it was easier to obtain the ripened shad.

Bristol was the place chosen and a site selected on the property of the late Walter Laing. Mr. Laing, himself, was also greatly interested in fish culture. On the banks of the Delaware river was erected a long, frame building with a porch, facing the river. On the first floor are one large and two small rooms. The large room is equipped with the jars and other apparatus needed in the propagation of shad. One small room is the boiler room, and the other is used as kitchen and dining rooms by the men in charge of the station. On the second floor there are two rooms, an office and a sleeping room.

The Bristol Station was not operated during the entire year, but was opened each season in time for the run of shad in the river. It was closed after the work of the spawning season was completed. Mr. Creveling, Superintendent of the Allentown Station, was also the Superintendent of the Bristol Hatchery.

Under Mr. Creveling's efficient management millions of young shad fry were hatched annually and planted in the Delaware river. In 1896-97, 7,325,000 shad fry were planted while the catch exceeded that of any previous year. This catch, at the nets, is valued at about half a million dollars a year, which in turn means a yield from the consumer of at least \$1,250,000. With due regard for the safe-guarding of the river there is no reason why the value of the shad fisheries should not increase steadily.

It is now a conceded fact that with the possible exception of the Potomac river, the Delaware is the greatest shad river in the world. Indeed rumor, founded on very good facts, gives the banner to the Delaware. Less than a century ago nearly all the shad rivers of New England and other states exceeded the Delaware in the yearly value of the shad catch, although that value at its best never equaled that of the Delaware catch of recent years.

This highly gratifying result is achieved through two principal means. One is, that destructive devices are prohibited and kept out of the river, and no additional dams are allowed to be built. The other is, that immense numbers of shad fry are propagated annually by Pennsylvania and the United States and planted in the Delaware.

Guarding the river and its tributaries as zealously as the Commissioners did, it was with genuine alarm and disgust that they learned of a bill which some New Jersey capitalists introduced into the Legislatures of New Jersey and Pennsylvania. This bill provided for the erection of dams about tide-water in all rivers of the two states, over thirty-five miles long. By its provisions, corpora-

tions would be invested with not only ordinary but extraordinary powers and privileges. But New Jersey promoters of the scheme reckoned without their host. The Commissioners and their allies, the Fish Protective Associations, the commercial fishermen, and others, conclusively proved the ruin such an act would compass and the bill was defeated in Pennsylvania.

Affairs did not always run smoothly for the Commission, however. By an unfortunate oversight, the Legislature of 1897 adjourned without making the necessary appropriation to the Commission to carry on its work. This was a dire misfortune and had it not been for the generosity of the various Fish Protective Associations, notably the Pennsylvania Fish Protective Association, and also many public spirited citizens, the misfortune would have become a calamity.

These people contributed private money to carry on the work of the Commission for the two years which must elapse before the next meeting of the Legislature, when a deficiency bill would be introduced for money to reimburse them. Twenty thousand dollars was needed to operate the hatcheries on a most economical basis. In spite of the efforts made it was impossible to raise all of this sum and the result was the closing of the Bristol and Erie hatcheries for this period.

That these two stations were selected was not a matter of accident. There was sufficient reason for the choice. The money subscribed came principally from the Fish Protective Associations and private citizens, but very few dollars being subscribed by those interested in the commercial fisheries. These few very fairly decided that under the circumstances the money should be used to operate the trout stations.

Fortunately for the Delaware river, the United States Commissioners appreciating the circumstances did double duty by that river. They not only planted all the fish hatched from the eggs taken from the Delaware shad that year, but also several million more taken from other waters.

But even this gracious act of the United States Commission did not indemnify Pennsylvania from all loss. The next year marked the beginning of the Spanish-American War. At the opening of the shad season, the United States Commission was notified that the "Fish Hawk" would be required for war service. Although the Pennsylvania Commission promptly offered the Bristol Station to the United States which offer was promptly accepted, the transfer from the "Fish Hawk" to the hatchery occasioned some delay. This together with the fact that the Pennsylvania Commission could not propagate shad at all that season, lessened the number of fry planted, by 25,000,000.

In 1899, 22,000,000 shad fry were planted in the Delaware river by the Pennsylvania Commission. Of this number five millions were hatched from eggs received from the United States Commission, while the remaining 17,000,000 were hatched from the eggs taken by the spawn-takers of the Pennsylvania Commission. The catch this year was also phenomenal both in numbers and the size of the fish. Ten and eleven pound fish elicited no comment. Eight and nine pound fish were common, while the average size weighed over four pounds.

Notwithstanding the fact that a very late spring prevented an early run of shad, when the water became warm such enormous schools of fish ascended the river and were caught in such numbers that the markets were full of them and prices were much reduced. In consequence of this some fisheries closed operations earlier than usual.

During the next year 23,869,000 shad fry were propagated and planted and the catch doubled that of any preceding season. As many as twenty thousand shad were sent to the Philadelphia markets in one day and at times it was hard to find sales at ridiculously low rates. Nevertheless, even at low wholesale prices the value of the catch grew steadily.

Markets for this delicious fish are found not only in Philadelphia, New York, Trenton, and other cities and towns within easy access of the Delaware, but are being rapidly extended to more distant cities. The increasing demands for the shad as a food are surely a splendid tribute to the value of the work done by the Pennsylvania Fish Commission.

When the Bristol Station was first built the hatching system installed was identical with that of Erie. In 1902, after the Legislature had made an appropriation along with New Jersey for experimental work in sturgeon culture, the Pennsylvania Commission removed one of the tables and erected a 300 jar battery. Unfortunately, owing to a reduction in the general appropriation in 1899, it became necessary to close the Bristol Hatchery for shad work, hence the batteries have never yet been operated for shad propagation.

WHITE FISH, PIKE-PERCH AND BLUE PIKE.

From 64,820,000 the number of fry hatched at the Erie Station in five years, beginning March, 1886, the number leaped to 106,896,000 for the single year of 1902. These figures convey, to some extent, the immensity of the work done at the Erie Station.

The work of this station is confined entirely to the propagation of commercial fishes. White fish, pike-perch and the blue pike are principal kinds propagated, although other species are also hatched.

Port Clinton and North Bass Island, in Lake Erie, are the fields for the gathering of white fish eggs. The eggs of the pike-perch are gathered in the spring from Lake Erie at Toledo, Ohio. It must not be thought that these places are vantage grounds for the Pennsylvania Commission alone. They are not. The United States Commission as well as the states of Michigan and Ohio derive their supply of eggs from the same source. Through the friendliness and courtesy of the United States Commission, however, an amicable agreement was made in regard to taking the eggs in the fishing grounds. The United States Commission has a station at Put In Bay, the Superintendent of which, is working in harmony with the Superintendent of the Erie Station.

Autumn is the spawning time for the white fish and on the weather conditions, depends in a large measure, the number of the output of fry. The eggs are shipped by rail to the Erie Hatchery from Port Clinton. The colder the weather is, the easier it is to ship the eggs without much loss, while warmer weather renders it exceedingly difficult to preserve the eggs in good condition until they can be placed in the hatching jars. Stormy weather likewise interferes seriously with the amount of eggs obtained, for the spawning season of this fish is of short duration.

Squally weather and heavy seas bring disaster to the spawn takers of the pike-perch also. These fish spawn in the spring. Medium sized fish produce the best spawn, that of the very large pike-perch being not so good.

Millions of pike-perch are hatched annually for distribution in the State. These are planted in Lake Erie, the large rivers, and the deep mountain lakes. Deep waters, having large, rocky bottoms are the only homes in which this fish will thrive. When planted the tiny fish go to the bottom of the streams at once and there secrete themselves under rocks or large stones. When planted in shallow waters, without rocky beds, the poor little things have no means of defence and are unceremoniously gobbled up by the cannibal members of the finny tribe.

Notwithstanding the fact that such vast numbers of pike-perch were planted every year, the poorest results were obtained from this fish. After a time the reason for this condition of affairs was ascertained. Each year the Commissioners received applications for millions of the fry to be planted in all sorts and conditions of streams. Bass streams, trout streams, shallow waters, were all named by the applicants as receptacles for the fry for which they asked.

The Commissioners, learning of this reckless planting and knowing full well the needs for this fish, of such rivers as the Susquehanna, the Monongahela, the Allegheny, Lake Erie, and the deeper

mountain lakes, refused the greater number of these applications. The applications of people whom they knew or who mentioned known waters were honored, but by far the greater number of fry were planted under the directions of the Commissioners. They argued, and rightly too, that it was a useless waste of time, money and labor to hatch fish to thus literally throw away.

Owing to the unfortunate oversight of the Legislature of 1897, previously described, the Erie as well as the Bristol hatchery was closed the following year. The deficiency bill which was finally passed in 1899, was also delayed and this occasioned more trouble. The Erie Station was closed for two years because of this lack of funds and as no notice had been given of the re-opening, the United States Commission very naturally engaged all the supply of eggs, feeling that it must exert itself to supply the deficiency occasioned by the closing of the Erie Station.

When the money supplied by the deficiency bill became available for use, the Superintendent of the station was dispatched at once for spawn for the hatchery. He found that all the eggs had been promised to the United States Commission. Fortunately for the Pennsylvania Commission, it not only possessed strong friends among the fishermen, but relations between it and the United States Commission had always been of a most cordial nature. Conferences were held and an arrangement made by which Pennsylvania received a portion of the spawn. As a result 24,080,000 pike-perch were hatched.

Because of the variety of commercial fishes handled at the Erie Station as well as the vast increase in numbers and the necessity for keeping the station open nearly, if not quite the entire year, the Commissioners deemed it expedient to appoint a separate superintendent for this hatchery.

Abram G. Buller was the man selected for the position. Mr. Buller received his training under the watchful eyes of Mr. Creveling, and his brother William Buller, Superintendent at Corry and also at Erie, prior to this appointment. It is rather a remarkable fact that all the brothers of this family chose the work of fish culture as their life work and that each one of them has risen to a position of prominence and earned the title of "expert."

To the Pennsylvania Fish Commission belongs the distinction of being not only the first but also, as far as is known, the only Commission that had undertaken the propagation of blue pike. The initial season for this undertaking was 1899.

As the eggs of the blue pike are obtained without much difficulty, the Commission determined to propagate it extensively, for as a commercial industry of the Great Lakes, within the limits of Pennsylvania, the blue pike is almost, if not quite as valuable as the

pike-perch. About 15,000,000 were hatched during the second season. The fishermen evinced keen pleasure in this undertaking of the Commission and demonstrated it in a practical way by giving the spawn takers all the assistance in their power.

The fish cultural work done at Erie has been prolific of most beneficent results. Since the introduction of artificial propagation the value of the commercial fisheries has more than doubled. Prior to that time about \$400,000 a year represented the value of the fisheries. Now it takes at least a million dollars to cover it and this amount is steadily growing. In Pennsylvania waters alone the value at the nets is over 300,000 a year.

The credit for this belongs to the Pennsylvania and United States Commissions. Indeed the fishermen of Lake Erie unreservedly and emphatically declare this, and manifest their appreciation by showing a strong disposition to co-operate in the work of fish culture. The increased value of these fisheries alone, compensates the Commonwealth more than a hundred fold for the money it expends for its entire work of fish culture.

STURGEON.

What is to be done to restore the sturgeon fisheries in the Delaware river, is a problem which caused grave anxiety to the later Commissions. Parallel with the extermination of the sturgeon is the extermination of an industry worth hundreds of thousands of dollars annually, and an industry in which nearly if not quite a million dollars worth of capital is invested.

Fifty years ago or less, sturgeon were so numerous in the Delaware river that it was not unusual for passengers on ferry boats to see three or four of them at a time leaping, during the passage between the two shores. During the season, great schools of sturgeon passed up the river daily. But that is the story of the past. The present brings us face to face with the grim fact that sturgeon have become so few in numbers as to mean practically extermination of the species.

This state of affairs is attributable to several facts. In the first place people did not always rate him at his proper value. Even his ancient lineage, for he is a survivor of the great Devonian Age, did not secure for him his proper standing among the "elect." Fishermen in casting their lines and nets for other fish, tossed him ashore as worthless. In this way large numbers were destroyed. Another reason, and this tends to emphasize the value of artificial propagation, the work of hatching sturgeon artificially had never been undertaken.

There is a great delicacy imported to this great United States

from Russia called "caviar," and with the delicacy there is a little secret with which but comparatively few are familiar. It is this: About nine-tenths of that same caviar was manufactured on the Delaware river, sent to Russia in kegs, there canned and labelled, and returned to this country as a Russian product. There is good authority for this statement.

Nor is the manufacture of caviar the only source of revenue from the sturgeon. The entire fish is valuable. Every part of it becomes a commercial product. The fish is sold fresh or it is cured and then sold. The head, hide and back-bone are used for manufacturing a fine oil used in tanneries. The nerve cords are converted into a sort of strong twine. The intestines are sometimes used for the manufacture of an article resembling tripe. The bones and other fragments are made into a fertilizer. The Chinese make soup from the gills and the marrow contained in the back-bone. At first the flesh was not regarded with favor by all classes, and the consumers for the most part were the poorer classes and the negroes. In some localities, it was sold for a time under the name of "Albany beef." Later, owing to the perfection attained in curing it, and the various ways it may be used, its circle of friends grew and large as the supply was for a time, it never exceeded the demand.

A statement of the number of the catch for two or three recent years may give the reader some idea of how grave the danger of complete extermination really is. In 1890, the average catch per net was sixty; in 1891, fifty-five; in 1892, forty-three; in 1893, thirty-two; in 1894, twenty-six; in 1897, twenty-two. From 1898 to 1903, nearly every net was operated at a loss. In 1903, for some unexplained reason there was a slight increase in the catch and some nets realized a small profit.

A keg of caviar weighed 135 pounds net. In 1885, the selling price of a keg averaged from nine to twelve dollars. In 1887, the selling price rose to \$52.00 per keg. In 1898, a keg sold for \$82.50, and in 1899, it required an average price of \$110.00 to buy one keg.

In the Delaware river and bay, in the year 1889, five thousand kegs of caviar were packed. In 1897, the number was not quite two thousand. The next year 1,442 represented the number of kegs. In 1899 there were 726½ kegs packed, while 308 kegs tell the story of the work of 1900.

There is but one way to save the fish and the industry from annihilation and that is artificial propagation. This process was attended with many difficulties, nevertheless the Commissioners were undaunted and having found a solution made brave though futile efforts to carry it out.

Aside from the difficulties, the propagation of the sturgeon is very costly. Special appliances and an extra force of men were

required, for the spawning time of the sturgeon would be the time the regular employes were busily engaged at the several stations.

Through the efforts of the Commission a special appropriation was secured for this work, but it was for too small an amount to permit Pennsylvania alone to undertake the work. The co-operation of New Jersey and Delaware was solicited for these states were in the same position as Pennsylvania in regard to the sturgeon industry. Unfortunately the Commissioners were not able to accomplish any practical work in propagating sturgeon artificially, not through lack of effort on their parts, but failure to secure from the Legislature a special appropriation to carry on the work unaided, or to secure the co-operation of other states.

That further efforts will be made there is no doubt for the Commissioners fully realize the necessity of preserving such a valuable industry. With artificial propagation, the industry would grow steadily in value for every dollar's worth of caviar would find a ready market in Europe to say nothing of the demand for it in this country.

BROOK TROUT.

Despite the fact that the army of trout anglers increases annually and that it is impossible under existing conditions to supply the demand for trout fry for planting, yet everything tends to show that the various trout streams of the Commonwealth are fairly well stocked with fish. During the first two or three years, before the work of the Commission was understood or appreciated, the demand for fry was so small that at least one-half the number had to be planted by the employes of the Commission. Now, even with taxing the trout hatcheries to their utmost capacity, it is impossible to satisfy all the demands, nor is it possible to estimate fully the exact number of fry requested, as applications would continue "to pour in" were it not that a definite time limit has been established.

Many are the demonstrations of the great value of stocking streams with artificially hatched trout. Many are the streams in this great Commonwealth that would be barren were it not for persistent stocking. These same streams now yield fairly good sport even though there are at least a hundred trout anglers to-day, to one, twenty-five or thirty years ago. Numerous brooks, also, are now the homes of the brook trout that in former years knew the little beauty not.

Finding accommodations in which to house the baby trout until the planting season, and not facilities for hatching it, was the difficulty which confronted the Commissions. A hundred million trout

a year could have been incubated at the two stations, but where to house them after they were hatched, that was the question. The Legislature alone could solve that question by appropriating sufficient money to erect additional houses and breeding ponds. Until such a solution was made the Commissioners could do nothing towards increasing the output of fry.

Planting the young fry in March was suggested but that was impractical. Injudicious planting is worse than none at all. March is generally on friendly terms with snow and ice which render planting difficult, even if the little fish were able to care for themselves and secure food without difficulty. Four months is deemed young enough to throw the little creatures on their own resources.

Overcrowding the troughs in the hatching houses was a condition against which to guard, for with overcrowding, the little fish refused to eat, became stunted, weak and anaemic, and finally died.

While millions of brook trout fry were planted annually, keeping the streams fairly well stocked and yielding a proportionate amount of sport to the angler, yet still greater returns would have been enjoyed, and the fishing interests increased, had it not been for a pernicious law. For a number of years five inches was the limit placed on the brook trout, yet a trout of that size is scarcely eatable. A trout does not spawn until it is at least six inches long. To kill a trout before it has reached the age of reproduction is to take a step towards the extermination of the species.

Pennsylvania was the only State which permitted trout to be caught at a five inch limit. All other states, engaged in the work of hatching trout, made six inches a minimum limit and some states even raised it to seven and eight inches. As a result the streams of Maine, Vermont, and New York were alive with trout even in the most populous districts, and yet not one of them could equal Pennsylvania in the annual output of fry.

The trout in Pennsylvania are precisely the same species and variety as those found in New York, Vermont and Maine, yet some people were of the opinion that they did not attain the size they did in these other states. The reason was apparent. They were caught before they had a chance to develop fully. If allowed to grow they will attain the same size as their relations in these other states. Fortunately for the anglers' interests as well as for the work of the Commissions, and the trout itself, the Legislature has recently raised the limit for killing trout to six inches and limited the number caught by each angler to fifty a day.

The work of the Commission was seriously handicapped by the conditions existing at the Allentown Hatchery. Occupied as it was on a lease, the Commissioners deemed it inexpedient to spend much money on permanent improvements. Only the most necessary re-

pairs, to prevent the buildings from actually falling down, were made. Many unsuccessful attempts were made to negotiate with the owner for the purchase of the property, for it was admirably adapted to the needs of the Commission, but all were unavailing. The owners refused to sell for what the Commission considered a fair price for the Commonwealth to pay. As a consequence, new sites were decided upon and a committee appointed in 1901 to secure them.

Aided by the newspapers, a number of sites were offered, of which two, one in Lehigh and one in Monroe counties, were decided upon. The sum of \$15,000 was asked and awarded by the Legislature for their purchase, but for reasons of economy failed to secure the signature of the Governor. This was a great misfortune to both the angling and commercial interests, as the Commissioners had planned to increase the output of game and commercial fishes. Not until the inauguration of the Department of Fisheries in June, 1903, were new sites secured and building operations began.

Several misfortunes have visited the Allentown Station despite the unceasing vigilance and expert management of the Superintendent, Mr. Creveling. In 1899, a most peculiar mortality visited the trout fry while still in the troughs. Over 2,000,000 fry were in the troughs about the middle of February. They appeared healthy except that they were very small for their age and occasionally seemed just a little languid in their movements, yet in less than three weeks they were every one dead.

Through the courtesy and interest of the United States Commission, Dr. Blackford was sent to make an investigation. The statistician of the Commission, Mr. W. S. Meehan, now the Chief Commissioner of the Department of Fisheries, also made an investigation. He ascribed the calamity to three causes; namely, Too long inbreeding which caused low vitality; a heavy blizzard; and, an flow of unaerated surface water, caused by a blizzard; and, an overcrowding of the troughs. Dr. Blackford maintained that the whole cause of the calamity was the too long inbreeding. The fish lacked blood corpuscles and had not sufficient strength to live to maturity.

The fish in the ponds had been used as breeders season after season. That the Superintendent recognized the danger in this is attested by the fact that on three occasions he asked for eggs or mature fish other than those at the hatchery. Unfortunately, through some misunderstanding or oversight, his requests were not granted.

But the catastrophe taught its own lessons. The Commissioners determined to obtain "new blood" for the Station at Allentown. For awhile eggs were obtained from other sources. It was found

that eggs could be purchased for about the same money that it cost to maintain breeders in the ponds. A contract was made with a New England firm for a supply of eggs, which gave entire satisfaction. The Blooming Grove Park Association also came to the rescue with a present of some 50,000 eggs. Of the fry hatched, a goodly number were retained for breeding purposes. This method was repeated without increased expense for two years longer, in order to give the new fry time to reach maturity, when they would be used as breeders.

In the meantime, the old breeders were planted in the various waters of the Commonwealth by the Superintendent and his assistants. It was also decided, after careful consideration, not to retain breeders after they became three years old, but when the eggs were taken to plant them, under the direction of the Commission, in suitable waters.

Knowledge and discrimination were both necessary factors to the successful planting of these mature fish, hence they were never distributed to citizens on application. With all their beauty, brook trout are cannibals and would like nothing better than to feast on the young of their own species. Therefore, but few are planted in any one stream.

The old adage, "Tis an ill-wind that blows nobody any good," seemed verified in 1902. In February of that year, a great storm swept Eastern Pennsylvania and carried 600,000 fry and about 12,000 breeders into the Little Lehigh creek. The storm waged furiously. Streams overflowed their banks, swept the ponds, completely submerged the troughs in one hatching house, and came within a half inch of doing so in the other. And the result? A decrease of 600,000 in the output of trout fry, and the loss of 12,000 breeding fish, but fine fishing in the Little Lehigh that whole season.

Had it not been for the wise management of Mr. Creveling and the timely aid of his assistants the loss would have been much heavier.

Another disaster overtook the left-over fry in the troughs at Allentown in 1903. Owing to the death of Mr. S. B. Stillwell, the President of the Fish Commission, there were some 300,000 trout fry left in the troughs; the applications in his hands not having been forwarded to the Station on June 1. On August 9, the fish began to die suddenly at the rate of several hundred a day. The United States Bureau of Fisheries was immediately notified of this and Dr. Marsh was detailed to investigate. He spent over two months at the Allentown Hatchery examining the dying fish and inoculating fingerlings brought from other establishments. In a report, which he subsequently made to the United States Bureau of Fisheries and to the Department of Fisheries of Pennsylvania,

he declared that the fish were anaemic and that possibly this disease was due to the trout having been retained in the troughs. He expressed his belief that while the former misfortune already described might have been due in part to inbreeding, that the present mortality could not be traced to that cause, since there had been a heavy admixture of fresh blood from several other hatcheries. It is only just to Mr. Creveling to say that the retention of the fry in the troughs beyond the period when they should have been transferred to ponds was not through negligence. He predicted the fatality. The failure to remove the fish was due to Mr. Creveling having been necessarily absent in the interests of the establishment of a new hatchery.

A growing disposition on the part of applicants for trout fry to delay sending their applications until late in the season, occasioned serious loss to the Commission. Late planting is attended with even greater evils than the too early planting of the fry.

Upon inquiries made, several reasons were found for the delay. Early planting in March and even April causes discomfort because of the frequent tendency of winter to linger in the lap of spring. Then there was also the mistaken idea that the older the little fish grew, the better able they would be to care for themselves. The injury to the fry seemed to be entirely overlooked by the applicant.

When the fry is planted late it is necessary to ship them in iced water. Generally the water in which they are planted is many degrees warmer. Such tender little things cannot accommodate themselves to such changes in temperature. As a result, they sicken and the large majority of them die.

Nor is the difference in the size of a six months and a four months old fish sufficient reason for delay in planting. In fact the difference is so slight that the four months old fish is just as able to defend itself from its enemies as the fish of six months.

For expediency's sake, a rule was adopted that no application for fry would be received after April 15th, and that the fish should be shipped at the time the Superintendents judged it best to do so. The new rule was received cheerfully and much is gained by it both in an economy of work and money.

One of the fruitful results of the work of the Fish Commissions is shown in the trout streams. Pennsylvania's trout waters are famous east of the Mississippi Valley. Thousands of anglers hurry into the Commonwealth on the 15th of April and whip the streams until the close of the season on the 31st of July. Every year there is a marked increase in the number of home and visiting anglers. Where there was one trout fisherman thirty-five years ago, in Pennsylvania brooks, there are now at least a hundred, yet the best

known creeks afford nearly as good sport as they did three decades ago.

As an example, it is said that for the last five years on the 15th of April, there have been from two to three thousand persons on each of the following streams: Newville Spring, in Cumberland Valley; Little Lehigh Creek, near Allentown, Lehigh county; and on Brodhead's Creek, in Monroe county. It is further stated that nearly every angler went home at the close of the day with fish in his basket.

As a matter of fact only small meadow streams in thickly populated districts, in counties like Chester and Lancaster, has it been found that a fairly good supply of fish have not been maintained.

The data reported to the Fish Commissioners and the Department of Fisheries indicate plainly that the fair maintenance has been the result of artificial propagation. If such conditions are obtained by the annual planting of from three to four millions of trout fry in the waters of Pennsylvania, what may be expected should the supply of fry be doubled or trebled.

BLACK BASS.

Black bass are not indigenous but introduced into Pennsylvania waters. They thrive in the new homes found for them by the Commissioners and would abound in vast numbers in the various rivers and streams of the Commonwealth, were it not for the low limit fixed by the Legislature for the catching of this fish and also for illegal fishing. The fecundity of the black bass is great and with proper protection, the planting of this specie would yield rich returns.

The science of fish culture has not yet discovered a way to express the eggs of the black bass, fertilize them and hatch them artificially. Even with the eggs and milt perfectly ripe, it is not only impossible to express them artificially, but the mere act of handling the bass, seems to prevent the natural operation of these functions. Pond culture is the nearest solution to artificial propagation yet discovered.

The black bass has always been a favorite game and food fish. Combined with its toothsome qualities as a food, its fighting powers are such as to greatly heighten the sport of the angler. The demand for this noble fish grows steadily until now it almost equals the demand for trout fry.

To satisfy the popular demand, the Commissioners purchased a number of bass each year and planted them in the rivers and lakes of the Commonwealth. About 10,000 were purchased annually for a number of years. For a time the waters were full of black bass.

This was about the year 1880. There were two reasons for this condition; first, the fish were allowed a good start before it was legal to fish for them; second, some time elapsed before the public generally, became acquainted with the methods of their capture.

But this desirable state of affairs did not long continue. The Legislature fixed six inches as the legal minimum limit for catching bass. Then the numbers of black bass began to decrease rapidly and continued to decrease in spite of heavy stocking. It is impossible to derive a steady income from a capital that is constantly being drained. This was the case with the bass. They were caught before they reached maturity. Black bass do not spawn before they are at least eight inches in length, hence to fix the minimum limit at six inches is to legalize, practically, the extermination of the species.

A number of attempts were made to induce the Legislature to raise the limit to nine inches but without avail. Nearly all other states had adopted the nine inch limit with the result that they could keep their waters well stocked. All attempts on the part of Pennsylvania to follow the example of her sister states were met with antagonism from some members of the Legislature and as a result the limit has never been raised.

This was most discouraging to the friends of the black bass. The Commissioners felt it was a waste of public money to purchase bass for planting under such conditions and they determined to discontinue the planting until such time as they could resort to pond culture. Besides the expense there were many other disagreeable features encountered by the Commissioners in securing the black bass for planting and distribution.

The first source of supply of the black bass was Presque Isle Bay and contiguous bays in Lake Erie. From five to ten cents apiece and bitter opposition from the people of Erie was the cost of each fish to the Commissioners. These people feared a diminution of the bass in the bay should the Commissioners continue year after year to derive their supply therefrom.

Therefore when a steady diminution did occur for several years, the really innocent Commissioners received all the blame. The real cause never occurred to the people. It was this: The inadequacy of the laws protecting the bass and the unnecessary slaughter of bait fish upon which the bass fed and which caused them to seek food in other waters.

Nevertheless, in order to satisfy the residents in the vicinity of Presque Isle Bay, the Commissioners sought another source of supply. Port Clinton, Ohio, was selected as the most available, even though the purchase of the fish at this place transferred the purchase money from Pennsylvania to Ohio. But it was not long

before the same agitation that occurred in Presque Isle was repeated at Port Clinton. These difficulties together with the futility of planting fish without proper protection determined the Commissioners to discontinue the purchase and distribution of bass until such time as they could construct their own ponds for breeding purposes.

Failing to secure a sufficient appropriation to permit them to establish a station for the exclusive culture of this much desired fish, the Commissioners decided to try some experiments on a small scale at the two trout hatcheries. Accordingly a couple of abandoned ponds at the Corry Hatchery and an old carp pond at Allentown were changed in construction and adapted as well as possible to the needs of the bass. At each station there were placed in these ponds fifty small mouth black bass and about one hundred rock bass.

Although these fish were apparently strong and healthy, a fungus attacked the black bass at Allentown, in the spring and speedily killed them all. The rock bass remained healthy as did the fish in the ponds at Corry. When the spawning season arrived, however, they gave no indications of spawning, although there were no doubts of their maturity. The conclusion reached was that the water was too cold for the successful propagation of black bass in large numbers.

The rearing of black bass is attended with many difficulties. Ponds must be constructed with special arrangements designed for this fish. The water must be of a certain temperature, not too cold, while the food for both the mature and young bass is a serious proposition.

In spite of the difficulties to surmount, the Commissioners determined to continue the experiment on a limited scale, in order to meet the ever increasing demand for this specie of fish. Three ponds were prepared at Corry for black and rock bass and Mr. Buller, the Superintendent, began his preparations for the new work.

In order to solve the food question, he began the propagation of frogs and by the close of the year had more than half a million tadpoles in one of the ponds and the hatching troughs. Mr. Buller also intends to breed German carp and roach. These with the tadpoles will furnish food for the bass.

After several seasons of experiments, Mr. Buller has at last achieved success in breeding black and rock bass. In a degree, this success was accidental. As the eggs of the black bass cannot be obtained in the same manner as those of the trout, the only hope of propagating them lies in their cultivation after they have been naturally deposited in the ponds. Although this was done assiduously by Mr. Buller success did not crown his efforts and after aban-

doing hope of ever attaining it, he transferred the bass to an old carp pond and left them to shift for themselves.

It was early in the spring when the bass were transferred to this pond. It was quite a shallow pond with a gravel bottom and plenty of lilies and grasses filling one side of it. When the spawning season approached, about the middle of May, the bass entered the shoals, made nests and deposited their eggs therein, which in a few days, were hatched. Mr. Buller was quick to note these facts and turn them to account in the future culture of the bass. These fish cannot be reared in large numbers, however, until a station specially designed for their needs is established.

THE DEPARTMENT OF FISHERIES.

In 1903, the legislature suddenly abolished the Board of Fish Commissioners and created in its place the Department of Fisheries. To most of the members of the Board of Fish Commissioners and to the general public, this action was unexpected. Nevertheless, the introduction of the bill, which undoubtedly placed the fishery industry of the Commonwealth in a more important place in the machinery of the government, met with the general approbation of the newspapers, the Fish Protective Associations and the public.

There was no serious criticisms of the work of the Fish Commission. Those who were responsible for proposing the change, together with many others who had been carefully following the fish cultural and fish protective work of the Commonwealth, were convinced of the necessity of it. They were cognizant of the increasing value of the fishery industry and for several years had entertained the feeling that the task was becoming too great for the members of the Board and that the system on which it was founded was becoming inadequate to meet the requirements of the work.

Under the law which created the Fish Commission none of its members received any salary or compensation for their services, excepting reasonable traveling and other expenses incurred while discharging their duties. As a consequence none of the members were able to devote their entire attention to the work. Yet, for the last three of four years, there was not a member who did not have to devote at least two hours daily to State fish culture and fish protective work.

It did not seem just to those who were deeply interested in the advancement of the fishery industry that men, however devoted they might be, should give so much time from their business to the Commonwealth without any compensation. More especially was this the case when the industry was estimated roughly to yield revenues to the people of between three and four million dollars an-

usually from angling and commercial fishing. Besides, under such conditions it was felt that they could not properly advance what was palpably a growing industry.

The Board of Fish Commissioners did what it could to meet the increasing work. It established the only system which was possible under the circumstances. It divided the State into six districts, assigning to each a Commissioner. The Commissioner was given authority over the fish protective work in his district, including the appointment of the wardens and the direction of their work. He was also given the supervision of the distribution of fish for his district.

To the President of the Board was assigned the general executive work, including the subject of transportation of fish, the signing of vouchers, the ordering of supplies and the calling of meetings. The hatcheries were supervised particularly by the nearest resident Commissioner. In addition, the Board appointed a statistician who was given general supervision and direction of the hatcheries so far as such supervision and direction did not include the expenditure of money, unless such expenditure was ordered by the Board at one of its meetings.

The great weakness of the system lay in the fact that there were thus created six distinct territories, the management of which was not uniform. Under the circumstances the most effective work was impossible. Furthermore, the system was unsatisfactory because it was not possible for even the members of the legislature, to say nothing of the general public, to secure perfect satisfaction. Very few knew to whom they were to communicate knowledge of violations of the fish laws, or to whom applications should be made for fish, or from whom to secure information relating to fish culture or fish work.

Instances have been known where at least two weeks elapsed before the proper Commissioner received word of a violation of the law which needed prompt attention. As a consequence of this difficulty and because no Commissioner could act outside of his district in the enforcement of fish laws, the protective feature of the Board was very weak. Less than \$1,300 were collected from fines for illegal fishing, from June 1, 1902, to June 1, 1903. Yet that year's work was far in excess of any previous year in the history of the Commission.

It was considerations such as these described which finally led to the drafting of the bill to create the Department of Fisheries. The initiative in the movement was taken by the Fish Protective Association of Pennsylvania, the oldest organization of the kind in the Commonwealth. The Pennsylvania Fish Protective Association is an organization chartered for the avowed purpose of

assisting the State and National authorities in the work of fish culture and fish protection. An active member of this Association has invariably had a place either in the Board of the Fish Commission or was officially connected with it. Col. John Gay, an active member, was president and secretary of the Board of Fish Commissioners. Andrew M. Spangler and Henry C. Ford, both active members, each held the presidency of the Board. W. E. Meehan, another active member, was first statistician and finally corresponding secretary.

The bill creating a Department of Fisheries was drafted on the lines of the act creating a Department of Forestry. By its provisions there was to be appointed at a salary of \$3,000 a year, a citizen, to be styled a Commissioner of Fisheries, and four other citizens to be called Fishery Commissioners. The five were to constitute a Board of Fishery Commission under the Department of Fisheries.

To the Commissioner of Fisheries was given full power to appoint and carry on the fish protective and fish culture work of the Commonwealth. He was made chief superintendent of all hatching stations and was to be given absolute control of all hatchery grounds and buildings. The entire force of employes, whether connected with the hatcheries or the warden service, and this included all the constables and peace officers of the Commonwealth, were to be placed under his jurisdiction. He was also to be given full control of the hatching and distribution of fish. By another provision he was to be president of the Board of Fishery Commission.

The duties of the Board of Fishery Commission were to be chiefly advisory to the Commissioner of Fisheries; his cabinet so to speak. To the Board also was to be given the power of making the rules and regulations governing the work of the wardens, and to issue bulletins concerning the work of the Department.

The Honorable Henry F. Walton, Speaker of the House of Representatives, and senior vice president of the Pennsylvania Fish Protective Association, interested himself particularly, in the bill to create the Department of Fisheries. It was drafted under his supervision and that of his law partner, John K. Andre, chairman of the committee on law of the same Association.

When prepared, the measure was intrusted to the Honorable Ira F. Mansfield, of Beaver county. The sentiment in favor of the bill was so strong that it passed the House of Representatives with only sixteen dissenting votes. It passed the Senate unanimously and was promptly signed by the Governor.

All the Fish Protective Associations and scientific bodies in Pennsylvania and many prominent business men in all parts of the Commonwealth, united in asking Governor Samuel W. Pennypacker to

appoint W. E. Meehan the Commissioner of Fisheries. Indeed, no other name was mentioned for the position. Members of the legislature, of Congress, and the United States Senate also united in the request.

Governor Pennypacker appointed Mr. Meehan on June 2, 1903. He also appointed John Hamburger, of Erie, and Henry C. Cox, of Wellsboro, former Commissioners; Charles L. Miller, of Altoona, and Andrew K. Whitaker, of Phoenixville, as members of the Board of Fishery Commission.

Mr. S. B. Stillwell, of Scranton, who for several years had been an efficient president of the Fish Commission, could not be considered as a member of the new Board, because of his death on May 29, 1903, just four days before the appointments were announced.

Under a provision of the act creating the Department of Fisheries, the Superintendent of Grounds and Public Buildings of the Commonwealth was directed to provide an office in Harrisburg for the new department and to furnish it with all the necessary furniture and supplies. Pending the rebuilding of the Capitol which was destroyed by fire a few years ago, temporary quarters were assigned the Department in the Fleming Building, 26 North Third street, between Market and Walnut.

On taking charge of the new Department, Commissioner Meehan found himself confronted with several complex problems. First, to establish a uniform warden system throughout the Commonwealth; second, to abate the evil of water pollution; third, to increase the effectiveness of the existing hatching stations; fourth, to locate and put in operation two new hatcheries authorized at the last session of the legislature; fifth, to endeavor to devise a plan by which New Jersey and Pennsylvania could unite legally in the fishery work on the Delaware river were a few of the tasks to be accomplished.

The first was a herculean task. Nearly all, of the few wardens scattered throughout the State, had been working at random and under different systems. Some, practically, did no work at all and seemed to consider their commission as something simply attractive, to be framed and hung on the walls of their dwellings. Others appeared to believe that their whole duty consisted in publishing in the newspapers the fact that they were wardens, with a warning to people not to fish illegally under threat of being arrested and fined. A notice also was posted on trees and public places warning people against illegal fishing.

With very few exceptions the great army of constables utterly ignored the law creating them fish wardens, and made no reports

either to the courts or the Fish Commissions, as provided by acts of Assembly.

The Commissioners at first appointed seven salaried wardens for the entire Commonwealth and assigned them special districts to be continually patrolled. There were also appointed about seventy-five special wardens, without salary, having jurisdiction in one or more counties. Besides these there were five special wardens, without salary, having jurisdiction in all the counties.

Under an act of the Assembly the special wardens are compensated for their services by receiving one-half of the fines collected from the convictions secured by them, and their expenses collected from the county or the defendants. To further stimulate the special wardens an order was issued by the Department securing them against loss in cases to which they were specially assigned.

The constables were notified that hereafter they would be held strictly responsible for the territory over which they had jurisdiction. Justices of the peace were also notified that they would be held accountable for the full discharge of their duties in relation to illegal fishing.

In a couple of instances magistrates, who refused to impose sentence, were haled into county courts, on a rule to show cause why they should not forthwith impose sentence, or have their commissions as committing magistrates revoked. One constable, who refused to take to jail prisoners convicted of illegal fishing, was arrested and fined.

On the other hand, justices of the peace and constables, who performed their duties fearlessly, were backed by the full power of the Department. Supported by the Department, one alderman was enabled to begin suit against county commissioners who refused to pay his just costs. Through the intervention of the Department in another instance, a constable was enabled, under the act of 1899, to bring before the court under the joint and friendly application of the district attorney and the county solicitor, his claim for compensation.

As a result of these proceedings an enthusiastic spirit was infused into most of the wardens and a large number of the constables. The magistrates also displayed a greater interest in the cases brought before them.

During the first six months of the life of the Department of Fisheries 142 arrests were made, of which 128 were convicted and fines aggregating to \$4,805 were imposed. Of this sum \$2,800 were collected, half of which, less the county treasurer's commission of five per cent., was turned into the State Treasury; a sum sufficient to operate one of the hatchery stations for nearly six months. The

other half of the money collected was paid to the wardens or constables making the arrests.

In addition to the arrests the wardens and constables seized or destroyed 56 devices and boats. Some of the boats and devices in themselves of legal manufacture, were sold and the proceeds turned into the Department of Fisheries.

This may be considered a remarkable showing for six months work of a Department newly created.

The activity displayed by the wardens and the evident sincerity of the Department to conserve the best interests of the commercial and sporting fisheries, evoked universal commendations from the press and enthusiastic aid from the Fish Protective organizations. An astonishing sentiment in favor of the enforcement of the fish laws was developed, even for those laws which many had considered as too drastic. The common saying is "Enforce the laws now and amend them when the legislature convenes." The sentiment in favor of enforcing the fish laws is particularly noticeable along the Susquehanna Valley and its branches, where previously illegal fishing was rampant.

Presenting more difficult features than the organization of the warden system was the problem of abating water pollution. A review of the situation in the Commonwealth showed that through sulphur and culm water, tannery and chemical refuse, and deleterious substances from many types of factories, fish life was absolutely destroyed in a majority of the large streams in the western sections. Through tanneries, paper mills, chemical works and saw mills, some of the streams in the northern section were depopulated. Poisonous substances had also killed the fishes in many streams in the eastern and southern sections.

Under one act, it was provided that tanks for purification should be erected in tanneries where vitrol was used in the process of tanning, in manufactories washing coal for coke, and in iron ore washeries. Scarcely a manufacturer obeyed this law. Only four of the nearly one hundred tanneries used vitrol and these at once complied with the law on notification from the Department. The others promised to employ any means to render innocuous their refuse tannery water which would not compel them to shut down. Unfortunately nothing has yet been found which can meet the reasonable proposition of the operators of the tanneries.

It is possible that a section of the act of May 29, 1901, commonly known as the dynamite or poison section, might be invoked to restrain manufacturers from emptying their poisonous substances into the streams. But a general and rigid enforcement of the section would mean the closing of establishments having invested capital to the amount of many millions of dollars.

This the Department of Fisheries did not feel justified in doing and it is now engaged in perfecting a plan which will prevent any pollution by new industries and cause an abatement of that existing from present manufactories.

From the Board of Fish Commissioners the Department of Fisheries received four hatcheries: the Erie Station at the city of Erie, Abram G. Buller, superintendent; the Western Station at Corry, William Buller, superintendent; the Eastern Station near Allentown, John P. Creveling, superintendent, and the Bristol Station at Bristol, not in operation.

For the sake of greater convenience the name of the Western Station was changed to the Corry Fish Hatchery. For the same reason the Eastern Station was called the Allentown Fish Hatchery.

The building at Erie was found to be in good condition but most of the structures at the Corry Hatchery were sadly out of repair. Hatching house, number one, was in imminent danger of falling from decayed base joints, while the floor joists of house number two were rotten. The majority of the troughs in both hatching houses were also badly decayed. The dwelling house was likewise in poor condition.

The buildings and fittings were immediately placed in first class repair by the Department. Additional ponds were constructed and other preparations made to increase the capacity of the hatchery for trout by more than one-half and also to insure an output of at least a million small mouth black bass in the near future. In fact that number of fry were hatched in July last, but before shipping time arrived a cloud burst tore out the ponds and carried the little creatures in the Venango river.

Several thousand gold fish were also hatched at Corry and distributed in public schools. The Department of Fisheries decided to make aquarium work in public schools an important part of its duties, believing that by so doing the young people would be more easily educated to the necessity and desirability, as men and women, of protecting fish life.

In consequence of the changes and additions made at the Corry Fish Hatchery, nearly 4,000,000 brook trout were hatched in the winter of 1903-04, an increase of 1,000,000. There were also hatched at the same place 1,300,000 lake trout, all but 300,000 of which were from the eggs gathered by the Department at Dunkirk, New York. The 300,000 eggs were received from the United States Government. A pond was also constructed at this hatchery for the propagation of frogs in the summer of 1904.

At the Allentown Fish Hatchery the buildings were in such a dilapidated condition that it was found impossible to repair them. This and several other facts determined the Department to abandon

this station on April 1st. The reasons which led to this determination were these: First, the rental of the hatchery ground which belonged to the Troxell estate, was considered excessive; second, the grounds were too small to admit of the expansion of the work of trout culture; third, the grounds were subject to floods from the Little Lehigh creek.

It was decided to concentrate the work at the Bellefonte Hatchery at Pleasant Gap, Centre county, a new station established under an appropriation for the purpose made at the last session of the legislature. Here 2,500,000 trout fry were hatched, making a total of nearly 6,500,000 fry at the two stations as against an average of 3,500,000 in former years.

The appropriation just mentioned amounted to \$15,000. Under the provisions of the act, two hatchery sites were to be secured, buildings and ponds constructed for this sum. Several counties contested for the privilege of having these two stations.

Early in July, 1903, Commissioner Meehan met a number of prominent citizens of Bellefonte and in their company inspected several sites that were offered in Centre county. Finally a site which seemed to meet all the requirements was found at Pleasant Gap station, on the Lewistown and Bald Eagle Valley Branch of the Pennsylvania Railroad, three and one-half miles from Bellefonte.

This land had a fair pitch besides having one large and several small springs within its area. A few hundred feet away there were also two huge springs which could be utilized. A large stream known at Logan Branch Run, with a temperature of fifty degrees in summer, flowed across the head of the grounds and along the length of it, separated from the property by a railroad embankment which prevented flooding of the grounds. It was estimated that from the springs and the creek there would be a supply of over 10,000 gallons of water a minute, over 1,400 gallons of which could be used for purely hatching purposes.

As a further inducement to the Department of Fisheries to locate at this spot the citizens of Centre county offered to make a free gift of all the land necessary for hatching purposes. They still further agreed to pay for extending a siding from the railroad tracks on to the hatchery grounds and also for the erection of a building in which to store the fish car and the cans for transporting the fish. The offer was accepted.

Headed by Judge John G. Love, Thomas H. Harter, editor and proprietor of the "Keystone Gazette," Wm. Montgomery, James Shugard, Colonel Thomas Pruner and Colonel W. F. Reeder, the citizens raised approximately \$3,500. With this sum they purchased the ground, fulfilled their other agreements and on August

9, 1903, formally turned over the property to the Department of Fisheries.

The citizens of Bellefonte made a gala day of the occasion, treating the Board of Fishery Commission as honored guests and making the presentation speeches in the court house. During the exercises it was announced that Mr. John P. Creveling, then superintendent at Allentown would be made the superintendent of the new station, to which was given the name, "Bellefonte Fish Hatchery."

Until Mr. Creveling was able to move his stock from Allentown, Mr. Nathan R. Buller, an assistant, was made acting superintendent. The work of building the new hatchery was placed under his care. A piece of land at the head of the hatchery grounds, comprising about two acres and containing a dwelling and other buildings was purchased for \$2,600. Under the terms of this purchase certain restrictions in former deeds were eliminated, a residence for the superintendent secured and a perfect rounding out of the property accomplished.

By this investment the Department acquired possession of a hatchery one-half mile in length, embracing twenty-three acres. Three acres of land was the gift of Colonel H. H. Pruner and was part of a farm owned by the late Daniel H. Hastings, a Governor of the Commonwealth of Pennsylvania.

The main spring was enlarged until it was 28 by 24 feet and its volume was increased by water brought from the Sugard spring about two hundred feet away, the water therefrom completely filling a twelve inch pipe. Nearby was built a hatchery house 100 feet long and 30 feet wide. It contained 74 troughs with a capacity of about 10,000,000 eggs or 2,000,000 fry. To accommodate the fry hatched from the other 8,000,000 eggs a device, called nursery ponds, recently employed by up to date fish culturists was adopted. These ponds were built against the outside of the hatchery house at right angles with it. There are ten of these ponds, each thirty feet long and nine feet wide and equipped with automatic feeders. The nursery and other ponds were constructed of concrete and every modern appliance known to fish culture introduced.

As the great flood which swept over the Allentown grounds in 1902 permitted the bulk of the breeding trout to escape, those which were left could only be depended upon to produce about 500,000 eggs. Besides, there were reasons which impelled the Department to decide not to use any fry of the stock at Allentown for breeding purposes. How therefore to provide for the Bellefonte Hatchery became a question.

Happily there was soon an answer. The United States Bureau of Fisheries contributed 3,000 fingerlings which would breed in the

fall of 1904. From the Penn Forest Brook Trout Company at Mauch Chunk, 7,000 more were purchased. The Blooming Grove Park Association made a gift of 3,000. Then an arrangement was made with the Commercial Hatchery at Weisport, by which Superintendent Creveling gathered all the eggs from the fish in the ponds at that establishment and in return for this service the Department was permitted to retain the surplus, amounting to about 500,000 eggs.

Next the Penn Forest Brook Trout Company came forward and offered all its surplus eggs on the sole condition that the Department send spawn-takers to their ponds. About 1,500,000 eggs were obtained from that establishment when further work was stopped by the setting in of severe winter weather. The Blooming Grove Park Association also made another gift to the Department, namely, 300,000 eyed eggs, so that by the first of January the new hatching house was more than two-thirds filled with eggs and fry.

In addition to the trout work which is the principal feature of the Bellefonte Fish Hatchery, it is designed to rear small mouth bass in large quantities and also to propagate gold fish for the public schools.

Here also will be constructed a lake about two acres in extent in which will be placed trout which have exceeded the age of three years. To a great extent, the fish placed in this lake will be allowed to shift for themselves. There is a definite reason for the construction of this lake. It has been found that after the trout reach the age of three years, the cost of their maintenance in ordinary ponds exceeds their value for breeding purposes. The Fish Commission always found a difficulty in disposing of this stock, not being inclined to plant them in ordinary trout streams where they could devour the young of their own kind.

By disposing of them in a large body of water in the hatchery grounds where they can find quantities of natural food, it is expected that the cost of maintenance will be reduced to a point where it will be profitable to retain the fish as breeders.

The work of constructing the Bellefonte Fish Hatchery was pushed with such energy that by October 9, 1903, it was formally opened and the first eggs placed in the troughs. In the short space of two months less two days after the ground was first broken this work was accomplished. On the first of November the car house was completed and the fish car entirely overhauled, indeed practically rebuilt, stored therein.

Shortly after the Bellefonte Fish Hatchery site had been chosen, an examination was made of proposed locations in the eastern and northeastern part of Pennsylvania. For a number of years citizens of the northeast had been making strenuous efforts to have a hatch-

ery located in Wayne county. Very liberal inducements were held out and a number of sites offered to the Department.

Under the guidance of a delegation from Scranton, Carbondale, Honesdale and elsewhere, Commissioner Meehan was taken finally to a tract on the head waters of the Lackawanna at Pleasant Mount in Wayne county. The spot was two miles from Herrick Centre on the Delaware and Hudson, and the Erie Railroads, and a mile and a half from a station on the Ontario and Western Railroad.

The ground had a pitch of about eight feet to the hundred. It was surrounded by dense woods and through it there flowed the main spring water source of the Lackawanna river, a stream which never became roily no matter how great the stream. A very large but undeveloped spring occupied a convenient spot at one side of the grounds and there were several other large springs in close proximity. The water of the large spring, although evidently from a greath depth in the earth, is intensely cold, a characteristic of all Wayne county springs. Even on a hot day in August the water of the Lackawaxen showed a temperature of forty-nine degrees.

Following the example of their fish loving friends in Centre county, the delegation attending Commissioner Meehan offered all the land necessary for the hatchery. At this juncture Mrs. Amos R. Sterling and her daughter, Miss Alison B. Sterling, came forward with a gift of sixteen acres. Mr. John P. O'Neill, who owned the large spring, gave it and the surrounding two and one-half acres of ground. The Mumford estate added about one and one-half acres more and Dr. C. C. Noble and others promised adjoining land as it might be required.

On October 16, 1903, the deeds were turned over to the Department of Fisheries. The occasion was made a general holiday at Pleasant Mount. Flags were flown from the buildings and the children of the public school given a half holiday. Followed by a large concourse of people the entire Board of Fishery Commission, escorted by Judge Purdy of the Wayne county court, and a committee of prominent citizens and members of the legislature from Wayne, Susquehanna and Luzerne counties, marched in procession behind a band to the public hall. There, with much speech making, the deeds were formally presented and the character of the work to be done at the station, described. To this station was given the name, "Pleasant Mount Fish Hatchery."

Trout in large numbers are to be incubated and for that purpose a commodious hatchery is designed. But the principal work will be the propagation of large and small mouth bass, rock and calico bass, pickerel, pike-perch, yellow perch, bull heads and Atlantic salmon. To incubate the eggs of the yellow perch, pickerel and pike-

perch, a hatchery house with the battery system installed, will be erected.

The great feature of this station, however, will be the ponds in which different species of bass are to be bred. Before it was possible to begin work on the Pleasant Mount Fish Hatchery winter set in and the start had to be deferred until spring.

Philadelphia had made a strong bid for the location of a hatchery within her borders, but a suitable site with sufficient acreage for pond culture on a large scale could not be found. An exceptionally fine site, however, was eventually discovered at Torresdale on the Delaware river, where a great filter plant is being built by the city.

Here is found a pretty ravine, a large spring, a copious brook, and a growth of noble trees. As this particular spot will not be needed for the filter beds for many years, the city councils of Philadelphia authorized the Department of Public Works to lease ten acres to the Department of Fisheries at an annual rental of one dollar. In return, it was decided by the Department to move the Bristol Station to this location.

By so doing the principal shad fisheries will be close at hand, while at Bristol the principal source of the egg supply is more than eight miles away. At the Torresdale Station it will also be possible to construct numerous ponds for the propagation of black bass, yellow perch, white perch, white and yellow cat fish and other river fishes.

At the time of writing this pamphlet there is an ordinance before the city councils of Philadelphia to appropriate the sum of \$5,000 to assist in putting the leased property into shape for fish cultural work. At the close of the Louisiana Purchase Exposition, it is also proposed to remove the Pennsylvania Live Fish Exhibit to this station, to which has been given the name, "Torresdale Fish Hatchery."

As the Delaware river marks the boundary line between Pennsylvania and New Jersey and also between Pennsylvania and New York, the Department of Fisheries felt that more effective work could be done if some method of co-operation could be devised. Accordingly, in January, 1904, a conference was held with the New Jersey Commission at a meeting in Trenton.

As a result of the conference three decisions were made: First, that a concurrent bill should be drawn by a member of the New Jersey Commission and the Commissioner of the Department of Fisheries of Pennsylvania, the same to be submitted to the respective legislatures; second, that some method of co-operative warden work should be devised; third, that Pennsylvania and New Jersey should spend dollar for dollar in hatching work, the first named State to incubate the eggs, and the latter to furnish them.

It was also agreed that the New Jersey Assembly be asked to ap-

appropriate a sum of money equal to that named by Pennsylvania in the spring of 1903, to experiment in the hatching of sturgeon. The belief was expressed at the meeting that if the two States could work together, at least three times the number of fish could be hatched and planted at an expense very little in excess of what it would cost Pennsylvania alone.

FISH LIFE IN EARLY DAYS.

More than two centuries ago the original inhabitants of the land now called Pennsylvania, and also the territory lying north, south, and west of this land, were a race of fish-eaters. Not that these people lived exclusively on fish but because fish constituted a staple and almost daily article on their menus, may these people be so termed. Nor is this strange, considering the habits of the race. They were not householders, devoting themselves particularly to the raising of crops, of flocks and herds, nor were they interested in the building of cities and towns. Incidentally, limited crops were raised by the women and used for food but the principal food was supplied by the men, obtained in the pursuit of their daily avocations when not engaged in strife with their neighbors.

These people were the original hunters and anglers of this continent. Many and valuable are the lessons which their skill in these pursuits has taught their white brothers. Although the flesh of the elk, deer and bear was also utilized as food, fish formed the principal and largest part of the food supply of these Indians, nor does this occasion surprise us when conditions are considered.

At this period, the rivers and streams were literally alive with fishes, both migratory and indigenous. Meadow and mountain streams teemed with countless numbers of trout, while every year multitudes of shad, herring and other migratory fishes, ascended the Susquehanna, the Delaware and the Schuylkill rivers, seemingly vying with each other to secure a place to spawn. Catfish, suckers and other fishes were also found in abundance.

Compared with the same species of fishes of to-day, those of the early times attained prodigious size. This size is determined by the remains of bones found in the ashes of ancient Indian villages. According to skeletons thus unearthed, trout must have weighed from two to four pounds each, while shad weighing twelve pounds to a fish were common.

Many phases of the life and customs of the Indians may be traced to the remains found in these primeval homes. Whether located beside a river or stream or whether some distance from it, in the ashes of their camp fires were preserved the bones of

many fish. Bones of other animal life, the deer, the bear, the elk, were also unearthed and while the quantity of these bones was great, it was small in comparison to the number of fish bones discovered, thus proving conclusively that the staple article of diet of these early Indians was fish.

These Indians also paid annual visits to the ocean. They often traveled from miles inland to reach the coast. Their visits were for definite purposes. They desired to gather mollusks which they smoked for winter use. Thus great heaps of shells were accumulated on the coast and in these accumulations were found the bones of many sea fishes as well as numerous fish spears and hooks.

It is natural to infer that the Indians, depending largely as they did on fish as a principal food supply, were expert fishermen. Indeed, not only the savage but the civilized Indian has proved himself to be wonderfully dexterous and clever in mechanical work. As fishermen, they were adepts. They not only employed all the devices used by the white race to catch fish but actually understood how to stupify the fish by the use of intoxicants. They built pens in which to lure and preserve fish until they wanted to use them.

Nor was the fishing confined to the Indian braves. The women and children were also experts in the art. The bow and arrow were the principal implements used by the Indian children to catch fish, and difficult as their task was, they acquired a dexterity in the use of these tools, which was truly marvelous. The fish not immediately consumed were preserved for future use by a process of smoke and sun curing.

On his treatise on the New England Indians, John Ogelby, a well-known writer says, "In the trade of fishing they are very expert, being experienced in all baits for different kinds of fishes * * * * * Since the English came they are furnished with English hooks and lines, for before, they made the latter of hemp, being more curiously wrought and of stronger material than ours and hooked with bone hooks. * * * * * They make likewise very strong sturgeon nets, with which they catch sturgeon of twelve feet or more in length. Their cordage is so even, soft and smooth that it looks more like silk than hemp." This same knowledge and skill were possessed by the Indians of Pennsylvania and no doubt were the acquirements of long practice.

Much interesting and valuable information concerning the Indians and their pursuits is given by such early writers as Loskiel, a Moravian missionary, Peter Kalm, Ogelby, Mahlon Stacy, and others. These writers claim that nets were extensively used by the Indians. This is substantiated by the type of decorations found on Indian pottery. Among the various relics found on ancient village sites were the remains of Indian pottery, many pieces of

which were decorated with the imprints of fish nets. Fragments of the meshes, themselves, were also found in the Mammoth Cave.

The vast numbers of spear heads found by archaeologists, testify silently to the fact that the Indians were extensively engaged in spearing and gigging. These heads bear evidence of the most skillful and delicate workmanship. Indeed, all the devices made by the Indians were so cleverly and delicately fashioned that the white settlers generally preferred them to their own.

The fisherman of to-day uses buoys to anchor his nets. The Indian used stones. These stones, weighing from fifteen to twenty pounds each, carefully trimmed, are often found in the various rivers of the Commonwealth, affording still further proof of the fact that the Indian was a diligent and painstaking fisherman.

In early colonial days the supply of fish seemed inexhaustible. Indeed, in some sections it was not only the chief food of the community but also the principal source of revenue. The fame of the shad fishing in the Susquehanna river was wide spread and induced settlers in other colonies to make new homes for themselves in its immediate vicinity.

In those days the average size of the Susquehanna shad was double that of the Delaware shad of to-day. Their flavor was also considered superior. General opinion attributes the superiority of the Susquehanna shad to the long run up the fresh water stream thereby giving strength to the idea of the survival of the fittest. Certain it is that numbers of settlers from the New York State line on the north, as far as Easton on the east, as well as a host of residents in and around Philadelphia, journeyed to the Susquehanna annually to secure their supply of fish. It was the custom of these people to camp on the banks of the river and to take with them all sorts of marketable commodities, which they exchanged for shad.

Attracted by the glowing reports of the shad fishing, a number of the Connecticut settlers removed their homes from that colony to the lovely and picturesque Wyoming Valley. They were a hardy and thrifty people. As soon as they were established in their new homes, preparations were begun for the operation of a number of shad fisheries along the Susquehanna.

The men formed themselves into companies of about ten each. They made their own nets, the flax needed for the purpose being raised by them, spun into twine by their wives and finally knitted by them into a seine. The seine was made in sections, each shareholder in the fishery contributing a section. These sections were knitted together, finished with the necessary corks and leads, and hung by those most expert in the work.

The fish were divided among the shareholders in proportion to the number of yards of the net owned by each. In a paper con-

tributed to the Historical Society of Luzerne county, a unique method of distributing the fish so as to avoid unfair discrimination, is described by the Honorable P. M. Osterhout. The catch was divided into as many piles as there were shareholders in the net. Then one of the men would turn his back and another one of the party, indicating a pile, would ask, "who shall have this, and who shall have that," the response being made by the man with his back turned towards the piles of fish and the company. These questions and answers would continue until all the piles would be given an owner. For many years this plan of dividing the fish was followed.

Cold and stormy days and evenings were given over to the making of nets. Fishing was done principally at night. From darkness until daylight the fishermen worked at the nets. An hour usually elapsed between "the hauls." This time was generally spent in relating fish stories and other marvelous tales of adventure.

It must not be thought that these early fisheries were common property. They were not. The owner of the ground was also the owner of the fishery and no one could fish without a permit. It was the custom of the owners to hire out their seines when not using them and to receive in payment one-half of the catch.

Peace, happiness and prosperity did not always reign in this lovely valley, however. Toil and hardships held equal sway. The coming of the Connecticut settlers occasioned trouble between them and the government of Pennsylvania over the right of possession of the Wyoming Valley. A war resulted, lasting many years and bringing in its wake much suffering, destruction of property and the other devastations of war. During this time, the settlers depended on almost entirely on fish for food and much destitution followed the destruction of some of the fisheries.

The Revolutionary War, the horrible Wyoming Massacre, were also sources of more hardships, but undaunted, these hardy pioneers defended their location in the valley although it was not until peace was restored at the close of the American struggle, that the fishing industries along the Susquehanna were resumed. As is the case in all conflicts many homes were left without protectors and to relieve the destitution of the widows and fatherless a special provision was made by the fishermen. It was agreed to give every year, one haul at each fishery to the widows and their children. The haul made the first Sunday after the shad fishing commenced was the one selected to give. It was designated "the widows' haul."

To the Wyoming Historical and Geographical Society of Wilkes-Barre we are debtors for much valuable information concerning the early fisheries along the Susquehanna. From the investigations made it was learned that a chain of fisheries extended along

the banks of the Susquehanna. A share in these fisheries was worth from ten to twenty dollars and occasionally a share was worth as much as a hundred dollars. The returns were large and it was not unusual for the owner of a share to net from three to four hundred dollars a year while sometimes as much as thirty or forty dollars a night was the portion of each fisherman. A half interest in the Hunloch fishery realized for its owner between five and six hundred dollars a year. A conservative estimate of the yearly net proceeds of these fisheries were \$12,000.

During the season, shad were salted and smoked in great quantities, not only for family use but as articles of exchange for other commodities. Every family of any means at all, possessed a half barrel or more salted shad and a number of smoked ones, for winter use. Every boat on the Susquehanna carried shad to exchange at various places for leather, cider, whiskey, salt, iron, and other merchandise. Cured shad from this section were carried up the river into New York State and down the river as far as Baltimore.

In these early days fish was not only plentiful but very cheap. These conditions however did not occasion joy and thanksgiving among all classes. To the indentured apprentice it often occasioned sorrow for cheapness being the recommendation, fish became almost his "daily bread." This was carried to such an extent in some places, that apprentices revolted and succeeded in having a clause inserted in their indentures which restricted the use of fish as a food to two days a week. Whether this was a triumph for the apprentice is a question for about that time the rage for Mexico sheep struck the community and a diet of mutton and molasses was substituted for fish.

Rising in the beautiful Catskill amid magnificent scenery, flowing south, separating Pennsylvania from New Jersey and in small part from New York, a majestic river finds its way to the sea. Draining as it does, a country celebrated for the grandeur of its scenery, rich in historic interest, and famous in verse, coupled with its own great beauty and power, the Delaware river is world famous.

Of all the rivers on the Atlantic coast the Delaware to-day, is pre-eminent as a shad river, while many of its tributaries enjoy a like reputation. Shad abound in Cooper's creek, and the Rancocas, above Gloucester City, also in Big Timber, Salem, Raccoon, Old Man's and Woodbury creeks, tributaries below Gloucester City.

Except for the brief description of his fishing in the Delaware, written by Mahlon Stacy, an early settler, to his brother in England, but little is known of the early fishing in this river. That William Penn recognized the importance of this industry is proved beyond doubt by the stipulations he made with the Indians at a council

meeting in the forest. Penn stipulated that to him and his colonists should be accorded the right to fish in the Schuylkill river.

It seems strange that knowledge about the early fisheries in the Delaware should be so meagre and equally unfortunate that no positive assertions can be made concerning this lack of knowledge. While there is no proof for the statement, there is a possibility that the English settlers on the Delaware entertained for the shad the same contempt as did the earliest settlers on the Connecticut river, years before.

The following brief quotation from Judd's History of Hadley, Massachusetts, may shed some little light on the subject: "The shad, which were very numerous, were despised and rejected by a large portion of the English for nearly one hundred years in the old towns of Connecticut, and for about seventy-five years in those Hampshire towns above the falls. It was discreditable for those who had a competency to eat shad, and it was disreputable to be destitute of salt pork, and the eating of shad implies a deficiency of pork. * * * * *

"There is a story told in Hadley of a family in that place who were about to dine on shad when it was not reputable to eat them. Hearing a knock at the door, the platter of shad was immediately hid under a bed."

Equally unknown is the manner of catching fish although it is thought that the seine was not used by the Dutch and German settlers until long after it had been employed by the Connecticut pioneers in the Wyoming Valley. The Indian plan of driving fish into pens is very possibly the method of fishing practiced by these settlers. Strength is given to this supposition by the facts contained in a letter written by an old settler of Port Deposit, New York. The letter refers to the fishing done in his youth and is an exact description of the Indian method of "penning" the fish. Just when seine fishing was introduced on the Delaware is not known positively, but it is thought not many years before the beginning of the Nineteenth century.

Located on a mighty river and its largest tributary, in direct communication with the ocean, Philadelphia occupies an enviable position as a great commercial center, yet previous to the middle of the Eighteenth century, the fish trade was only sufficient to support those who sold at the fish stands around the vicinity of Second and Market streets. A number of years later, about 1764, a fish market was erected although it is said, except in cool weather, the demand for fish was comparatively small.

In 1751, the earliest shad fishery well known in the Upper Delaware was established and was designated the Point Fishery. Unlike the fisheries on the Susquehanna, the hauls at this one were

made in the day-time, and it was termed a "day" fishery. The establishment of the Point Fishery was followed by a number of others, some on the New Jersey side, in the Upper Delaware.

As to the time of drawing the nets two district customs were observed by the fishermen on the Delaware. With scarcely an exception all the fisheries above Easton were operated at night, the fishermen claiming that the shad run more freely in the darkness, remaining quiet in eddies and deep pools during the daylight. Below Easton, the nets were operated both during the day and at night. The method of dividing the fish used by the early Susquehanna fishermen, was also employed by the early fishermen on the Upper Delaware and is still the custom.

Winding in and out most gracefully, among mountains, hills and valleys, amid scenery most picturesque and glorious, the Schuylkill river wends its way to the Delaware. In the early history of the Commonwealth this beautiful stream was celebrated as a shad river, but in this one respect its glory has departed for the shad no longer seek it for a spawning bed. This is due to the abuses practiced by the greatest enemies known to the finny tribe—man. With the building of dams, pollution of the water, and the use of destructive devices, the fame of the Schuylkill as a shad river waned, until now a shad is never seen in its waters.

William Penn not only recognized the value of the Schuylkill as a fishing ground when he stipulated with the Indians for the right to fish in it, but further attested to its excellence in one of his letters in which he explained that "six hundred shad had been taken with one sweep of the seine."

To His Excellency, the Hon. Samuel W. Pennypacker, Governor of Pennsylvania, is the Commonwealth indebted for its most valuable information concerning the early fisheries of the Schuylkill river. Governor Pennypacker is not only one of the most eminent antiquarians in the Commonwealth but also possesses rare literary ability. The results of his many researches are most valuable because of their absolute accuracy. His writings are most interesting from two especial standpoints. Not only is the reader refreshed by the scholarly and masterful style of the author, but he is filled with the delightful satisfaction of knowing that what he reads is absolutely reliable information.

In his book "Phoenixville and Vicinity," Governor Pennypacker quaintly describes these early fisheries. The different devices used to catch the shad, the several bills enacted to regulate the manner of fishing, the tribulations of the fishing fraternity, the locations and resources of the various fisheries are all set forth in due form.

Governor Pennypacker's description of what he designates as "perhaps the only naval battle ever fought upon the Schuylkill," is

most interesting and unique: "The opponents of dams and weirs succeeded in preventing the act (permitting the use of them) from becoming a law, but their views were not enforced without resistance. The fishermen of Long Ford were too stout hearted and too tenacious of the privilege they had for years enjoyed to yield without a struggle, and the use of the racks was continued despite of the legislators.

"Finally, in 1738, their exasperated adversaries up the river organized a force of volunteers, as formidable from the numbers and courage of its constituents as possible, collected a fleet of canoes, and under the command of Timothy Miller, a man of great muscular strength, set sail on the 20th of April, intent upon desperate deeds, and in full anticipation of success. Arriving at Long Ford they commenced a work of havoc among the racks, which they broke away from the moorings and sent adrift down the stream. A few of the fishermen, who chanced to be there when the fleet appeared, at first attempted with soft words to stay the destruction which was being committed, and, finding prayers and entreaties ineffectual, seized upon the loosened racks and endeavored to carry them away.

"This did not suit the purpose of the assailants, who pursued and relentlessly dragging the implements from their grasp broke and cut them into pieces. It was more than could be endured. Abandoning temporarily the disputed ground, they fled into the settlement, sounded the slogan and summoned to the rescue every man, who could handle an oar or wield a club. Thus reinforced they returned to the encounter, and in their canoes made a furious assault upon the fleet of the enemy, which still unwisely lingered about the scene of demolition. The struggle that ensued, whose issues perchance depended more upon individual strength than skillful manoeuvring, became desperate, and for a long time Mars or Neptune which ever we may suppose to have been the presiding divinity, maintained the utmost impartiality. The scale was finally turned by the valor of Thomas Valentine, the tenant at the knoll, who leaped into the canoe of the opposing commodore, Timothy Miller, struck out lustily upon all sides with a club, and after beating down every man of its crew succeeded in effecting its capture.

"This serious loss dampened the ardor of the assailants and Miller, his thumb broken and his companions overpowered, was compelled to order a retreat. Encouraged by the unexpected advantage, the victors pressed their antagonists closely and the retreat soon became a rout. The beaten squadron fled rapidly down the Schuylkill, and in order to escape their pursuers, who followed with the utmost pertinacity, made the grave mistake of entering the Perkiomen.

"This stream was too shallow for navigation, and the canoes soon running aground, the crews were compelled to seek the shelter of the forests for safety. A complete destruction of the boats and their contents satisfied the vindictive ire of the fishermen, who returned to their homes elated with a triumph which had been dearly purchased with many severe wounds and the loss of their racks."

While shad have become foreign to the waters of the Schuylkill, many other fishes find a home in this river. Wonderful are the stories related by some of the old residents on its banks, of the marvelous catches made in their youth. With the use of a dip-net, it was nothing extraordinary to catch 3,000 catfish in one night. Large numbers of rock fish and perch were also caught, as many as from 30 to 80 pounds accruing from one morning's work with a hook and line.

Many famous clubs were located along the banks of the Schuylkill, both before and after the Revolution. One of the most famous is the "Schuylkill Fishing Company of the State in Schuylkill," which was founded in 1732 and is still in a flourishing condition. The original home of this club was at Warner's Hill and for the building used was paid a rent of three fresh sunfish every year. Another club which antedated the Revolution was that of old Fort St. Davids, located where the Fall of Schuylkill now is.

At the Falls of Schuylkill, Philadelphia, on the banks of the river were situated a number of wayside inns, famous for their catfish suppers. Not only the residents of Philadelphia and vicinity, but travelers from more distant points were regaled at these inns, where deliciously cooked catfish, spring chicken, waffles, coffee and other condiments were served to tempt appetites already whetted by drives or rambles through the historic Fairmount Park.

EARLY FISHING ON LAKE ERIE.

Before the advent of the white man on its shores, the beach at Lake Erie was not only much larger than it to-day, but the low lands nearest the shore were covered by a thick forest. The lake itself, abounded in black bass, lake pike, white fish, grass pike, perch and other varieties of game and food fishes. Presque Isle Bay, Misery Bay, Mill Creek, and in fact all the waters of Erie county teemed with fishes.

The first fishermen in these waters were the Indians. About the year 1796, a number of Seneca Indians selected Massassauga Point, at the head of Presque Isle Bay, as their place of abode. This was the last Indian village established in Erie county, Penns., although previously numerous Indian villages flourished in north-west Pennsylvania, the inhabitants of which assiduously fished.

About the same time (1795) a number of white pioneers made their appearance as settlers in the same locality. On the east side of Mill Creek, forts were built and occupied by soldiers. These, as well as the pioneers and Indians, depended largely on fishing for their daily food. Canoes were constructed out of logs and were as necessary to the existence of the little community as were the log cabins. The cabins afforded the needed shelter, while the canoes made possible the needed food.

Each settler owned a canoe and in it went fishing, whenever the family larder needed replenishing. The Indians, quick at making bargains and exchanges, made their fishing profitable by selling their catches to the whites. After a time, the Indians abandoned the village. Subsequently a half-breed negro occupied the site. He called himself McKinney, and he, too, was a fisherman. McKinney had several daughters, one of whom married a man named Ben Fleming, who was said to be the last survivor of Perry's fleet residing in Pennsylvania. Fleming was also a famous fisherman and followed the trade as a means of livelihood.

These early fishermen used exclusively the hook and line method of catching fish. Nets were not used previous to 1830 or 31. About that time David Towzier made his debut as the first seine fisherman. He was followed by others and seine fishing became popular in lake and bay. Nets were finally used by all those engaged in the work as a means of livelihood, the hook and line method being employed by those who fished for sport.

Many of the early residents of the city of Erie and vicinity corroborate the reports of the great abundance of fishes in these several waters. Besides the other varieties mentioned brook trout, sunfish and rock bass were very plentiful in all the streams. The fishery trade was established in the early part of the nineteenth century in Lake Erie. From a very modest beginning it has now assumed very great proportions, increasing the revenues of the Commonwealth to the amount of \$300,000 a year.

At first, the fish caught were cleaned by the fisherman, strung on a line, about five to a string, and sold from house to house. Then about 1824-26, a few small vessels sailed from Erie to Mackinac every autumn to engage in fishing for commercial purposes. The fish caught were cured, packed into barrels and returned to Erie. There some were sold and others shipped to Pittsburg.

Shortly after this one of these vessel owners, Captain John Dixon, built a dock on Lake Erie. He also erected the first warehouse in the city of Erie, thus focusing the fishery business at this point. From 1830 to 1850, fishing along the Pennsylvania frontage of Lake Erie was conducted along these lines. Railroads into Erie were unknown and although the city was naturally a great commercial cen-

tre for the fishing industry of the lake, yet the market for fish was then necessarily limited.

Then came a discovery which has added enormously to the value of the fishery industry of Lake Erie. Captain Nash, of Mackinac, in 1852, proceeded from that place to Dunkirk, New York, on Lake Erie, with two fish boats, for the purpose of trying an experiment. He sailed a few miles out of the harbor, set his nets and his first haul was a large catch of white fish. Much notoriety was given the matter by the newspapers of Dunkirk, Buffalo and Cleveland, and the event signalled the beginning of a very large trade for this very desirable food fish. Previous to this discovery it had been the custom for persons of means to send to Mackinac or Detroit for their yearly supply of sugar-cured white fish.

Other cities followed the example of Dunkirk and soon other cities, notably Erie, were extensively engaged in the white fish industry. At that time the white fish averaged from six to twelve pounds although heavier ones have been caught also. Some of the fish were sold fresh, some sugar-cured for families and other cured and packed to be sold to grocers and other dealers. They were shipped from Erie, east and west to a number of cities.

Sturgeon were also abundant in Lake Erie, but they were regarded as worthless. This was of course previous to the days of smoking the flesh, and converting the roes into caviar. Thousands of them were caught and buried in the peninsula for lack of a better way to dispose of them. Large numbers were given to farmers also, to be used as fertilizers for their fields. Later the meat was smoked, being sent to Sandusky, Ohio, for that purpose. It was then sold at a merely nominal price. This wanton destruction of the sturgeon has finally resulted in its almost complete extermination and the destruction of a very valuable industry.

DESTRUCTION OF FISH LIFE IN THE STATE.

Despite the fact that in the early days the waters of the Commonwealth abounded in various forms of fish life, this happy condition did not continue to prevail. The early part of the nineteenth century marked the beginning of a perceptible diminution in the fish life of the various waters. This diminution was occasioned by several principal causes; namely, the erection of dams in the rivers, illegal methods of fishing, the use of deleterious substances, excessive fishing, and water pollution.

In 1815, the erection of two large dams across the Schuylkill was begun. They were completed in 1818. One of these dams was at Flatrock, now called Shawmont, and the other at the city of Reading. A few years later, a third dam was constructed at Fairmount.

In the first two instances, the Schuylkill Navigation Company was the culprit, in the third, the city of Philadelphia.

The Schuylkill Navigation Company was incorporated on March 8, 1815. Its arbitrary acts and the destruction of fish life caused by the dams it erected, engendered much bitter feeling amongst the people of the community. Hence every possible opportunity for a suit for damages against it was eagerly seized and the Company was not usually the victor.

The dam at Fairmount was constructed in the interests of the water supply for the city. Whatever the gain in this direction, the immediate result was the destruction of the fisheries for migratory fishes above the dam. Below Fairmount the fishing continued to be good for the next few years. Then the gas works were erected and their refuse being emptied into the river completed the destruction of the Schuylkill fisheries.

Nor did the Delaware escape. About the same time the Lackawaxen dam was built. While this dam was low enough to permit the passage of shad in high water, nevertheless it interfered greatly with the free passage of these fish to their spawning beds. The erection of the Lackawaxen dam was incentive to the citizens of New Jersey to make efforts to have similar ones constructed at other places on the Delaware. Indeed some of these acts passed their legislature but failed to become laws for lack of concurrent legislation on the part of Pennsylvania. The Lehigh river was also a sufferer. A dam was erected in it near the place it empties into the Delaware.

Too much cannot be said in condemnation of the fish baskets and other illegal devices used by many fishermen. Mr. Howard Reeder, one of the earliest Commissioners, in a report made by him in 1874, says:

"Of all implements for the wanton destruction of fishes which have ever been constructed by human skill the one most worthy of condemnation is the ordinary fish basket. These instruments of extirpation are placed in the mid-channel of the river, with long arms or wings made of stones, extending upon either side towards the shores. Every living creature carried by the current is swept into these baskets. Young shad are particularly delicate. A blow which displaces a scale will result in the death of a fish, so that scarcely a young shad which succeeds in going through the slats of the basket will live, while millions are stopped upon the basket and there allowed to die. Instances have come to our knowledge where, in 1870 and 1871, parties owning baskets were obliged to shovel out with a wooden scoop the young shad that had accumulated in their baskets in less time than one night. In one instance the owner of the basket said that he thought in one night he had

thrown from his fish basket *more than a cart load of young shad*. It is not probable that one survived.

“* * * As an engine used for the destruction of fish, the set-net or fyke-net is surpassed only by the fish basket. This net is an elongated trap with a large mouth set directly in the current of the stream, sometimes with long arms or wings of stone extending out similar to the fish basket, turning the entire current through the net and sweeping into it every living creature carried by the current. These nets require no attention and no labor. They are simply deposited and left to take care of themselves until the owner is ready to take them up and empty them of their catch. Occasionally along our large rivers you will find a man owning as high as thirty or forty of these nets.”

Smaller and smaller grew the numbers of fish caught each year until finally in the early seventies, the fisheries could not meet their expenses. The size of the fish also greatly decreased. In 1843, a pork barrel could not accommodate more than about forty shad. In 1873, more than a hundred shad found commodious quarters therein.

The story of the Susquehanna is but a reproduction of the sad story of the Delaware. Rich as this river was in shad and other fishes it, too, succumbed to the evil influences of illegal devices and dams. In 1830, the Tide Water Canal Company erected the Columbia dam. This was followed by a number of others being erected as feeders to the canals along the Susquehanna. True, the Tide Water Canal Company bound themselves to keep in the dam an open passage for fish, but for many years they failed to comply with their agreement.

Nor does the story of this wanton destruction end with the rivers of the Commonwealth. It was extended to meadow and mountain streams and the lakes. Abominable devices and even deleterious substances were alike employed. Fish baskets, set lines, seines sweeping the streams, lime, dynamite and other explosives were all freely used and man richly earned for himself the title of “the worst enemy of the funny tribe.”

The increase in population marked a similar increase in the growth of mills, factories and other industrial establishments. These also are contributing their share to the destruction of fish life. Saw dust, culm, tannic acids, dyes and other like substances are causing a water pollution against which the authorities are still battling and striving, with many of the manufacturers, to overcome.

With utter disregard for the legality of the devices used, ignoring completely the spawning season and finding a ready market for unseasonable fishes, the fishermen of Lake Erie until within recent

years, succeeded in nearly ruining the lake fisheries. By degrees the white fish industry, once very large, so decreased as to become unprofitable and had to relinquish its claim to first place among the fisheries of the lake and indeed was almost entirely abandoned as a separate industry. This was about 1885. Extensive ice fishing was also indulged in, winter after winter, and the catches sold openly in the markets. Finally in March, 1893, the Erie Herald, in a strong article published, called public attention to this nefarious trade and called on all anglers to exert themselves to prevent the illegal catching of fish.

DECREASE IN SMALL MOUTH BLACK BASS.

In nearly all the waters of the Commonwealth a mysterious decrease in the small mouth black bass is taking place. This was first noticeable about four years ago. The story has been told of the remarkable adaptability which this great game fish exhibited when first placed in the rivers and lakes of Pennsylvania from the Potomac river and certain lakes in Dutchess county, New York.

For many years every body of water possessing the proper requirements literally teemed with small mouth black bass. Then about 1899, from many quarters it was suddenly reported that very few and sometimes no young bass were seen in the summer. Indeed two or three years previously, a few streams in Eastern Pennsylvania, like the Wissahickon, Meshaminy and Pennypack creeks were reported to be almost depopulated.

Causes were assigned which did not occasion general alarm, but when, in 1899, the absence of a quantity of small fish was reported in the Delaware, the Susquehanna, the Allegheny rivers, and numerous other waters, wide spread attention was given to the fact. The following year, a greatly lessened number of large fish was reported to have been caught. Since 1899, anglers generally, declare that scarcely any bass fry have been seen.

Luther Michael, a well-known angler, residing near the Delaware Water Gap, says that there has been no over-fishing in the Delaware river at any time since the introduction of the black bass in 1870; yet no small bass of any account have been noticed in the Delaware for five years. On the other hand the river is fairly teeming with chubs, suckers and other inferior or useless fishes, showing conclusively a marked absence of mature black bass.

Mr. Michael's testimony is the same as that of other anglers residing along the Susquehanna Valley. But the report of Mr. Michael and others on the Delaware river, apparently disposes negatively of one of the principal reasons advanced by residents on the Susquehanna. They maintained that the causes of the rapid decrease of

the number of bass in the Susquehanna were as follows: First and foremost, pollution by culm or culm dirt; second, by German carp; third, by excessive illegal fishing and destructive devices; fourth, a failure to restock for several years.

It was held that the culm dirt settled on the spawn beds and either destroyed the eggs or left such a deposit of mud on the bottom of the river as to make it impossible for the fish to clear their nests; second, they contended, first, that the carp destroyed eggs that were deposited; and second, that they destroyed the water plants which afforded a haven for the fry and on which larvae of insects and other water life gathered upon which the fry lived; third, that among the principal illegal and destructive methods were fish baskets, gigging or spearing, and the catching of undersized fish, the State law permitting immature fish to be caught.

This seemed a very strong presentation, but nearly all of these causes do not apply to the Delaware river. Above Easton there is not a particle of either culm or any other polluting substances flowing into the Delaware. Fish baskets are almost unknown, gigging is rare, and there never was an abundance of water plants above Trenton Falls. There remains therefore only the well-known spawn-eating habits of the German carp, as a corroborative of the lessening numbers of the small mouth bass, and the possible fact that there has been no restocking for several years. It is no wonder then that anglers are bewildered over the whole matter.

A theory has been advanced which is rapidly gaining adherents. It is this; that the cause of the diminishing number of black bass is due to the fact that it is not indigenous to Pennsylvania waters. It has been noted frequently that when fishes have been taken from their native environment and placed in new surroundings, they either refuse to propagate freely or if they do so at first, their progeny eventually becomes barren or nearly so. The same strange dispensation of nature has been noticed in other forms of animal life, in some forms of vegetable life, and even in human life itself.

This may then be the reason for the sudden and rapidly diminishing supply of small mouth bass in Pennsylvania waters. If it is, there is but one remedy, namely: artificial propagation and constant planting of vast numbers of young fish, the parents of which must come from waters in which the great game fish is indigenous.

FISH LIFE AND PENNSYLVANIA FISHES.

There is a remarkable resemblance between fish and vegetable life in their earliest stages. Take the seed of a pea, for example. At first it is dry and wrinkled; but after a brief contact with moisture the seed swells and the wrinkles disappear. In a few

days the skin splits, a shoot starts upward into the air and a tiny root fastens itself into the earth. Two thick leaves appear, termed cotyledons or seed leaves. At this time the little plant, instead of drawing substance from the earth feeds on the contents of the cotyledons. It is not until this nourishment is exhausted that the little plant seeks food from the earth. The egg of a fish, like the seed of a plant, becomes perceptibly larger after contact with water. When the little fish is hatched there is found attached to the under side of its body a bag, called a yolk-sac. The contents of this sac nourish the tiny creature, just as the cotyledons fed the baby plant. Finally, when the sac is absorbed, the little fish seeks food in its native element, just as the little plant in a similar stage, turns to the earth for its nourishment.

Fish life is absorbingly interesting from its very earliest stages. While the great design of life in fish is the same as in vegetable and warm blooded animal life, the whole character, habits and being of fish differ from either. It is not easy to define a fish because others are creatures which have prominent characteristics belonging to them without being of them. A whale, for example, has the form and tail of a fish, yet it is a warm blooded creature. A tadpole possesses gills and in its early stages, the general outline of a fish. It is cold blooded, yet it is known to be embryotic frog and not a fish. A water dog possesses gill-slits, but likewise is not a fish. On the other hand there are certain genera of fishes which might easily be mistaken for some other order of creatures.

A fish is a vertebrate having cold blood, scales, gills and fins. The chief propulsive power of a fish is by sinuous motions of the body similar to those of a snake and not by means of the fins. The chief functions of the fins are for balancing and steering. It is a curious fact that fishes, when first hatched, often possess fins or coverings to the body, which disappear when maturity is reached. The brook trout, for example, in its earliest days, has a fin closely resembling that of an eel, portions of it afterwards disappearing. The sturgeon, in its early days, is covered with a complete suit of armor, which nearly all disappears when the fish reaches maturity.

Should a live and healthy fish be handled it will be found to be covered with a thick coating of slime. The substance which is exuded from the body of the fish is as necessary to its health and life as perspiration is to man. The number of fins vary with different species of fishes but every fish possesses dorsal, caudal, anal and pectoral fins. The head of a fish ends at the back of the gills; then follows the trunk, and finally, the tail.

A few warm blooded animals possess very large eyes but the majority of fishes possess large eyes when compared with other forms of vertebrate life. But the size of eyes in fishes varies ac-

according to the character of the water they habitually inhabit. Those of nocturnal habits and which dwell at great depths have very large eyes, while those which live in muddy water or in that part of the ocean where light can scarcely penetrate have very small eyes. So called blind fishes found in caves either have rudimentary eyes or eyes covered by skin.

The majority of fishes, like dogs, swallow their food unmasticated and it is believed that the sense of taste is not very keen. While fishes apparently exhibit no appreciation of pain their sense of touch is exceedingly keen. In this particular, the seat of greatest sensitiveness is about the snout and some fishes are provided with special organs for the further development of this sense; the barbels of the catfish, for instance.

It seems almost incredible, but nevertheless it is a fact that carnivorous fishes can swallow others larger than themselves. The power of distension of the stomach and gullet is accountable for this fact. It is perhaps this ability to swallow something larger than itself which makes the fish so exceedingly voracious. Of all living creatures there are none which equal carnivorous fishes in ruthless pursuit of prey. Even a tiger, when his hunger is satisfied, will cease to slay and seek the seclusion of the jungle; but a carnivorous fish, when it has gorged itself and its distended stomach can hold no more food, continues its slaughter. It darts hither and thither among its prey, slaying right and left; biting them in two and allowing the pieces to float away unheeded. It seems to kill for the mere pleasure of killing. A school of blue fish will frequently follow a school of menhaden for hours after their appetites are satiated, slaying continuously, and the water is streaked with grease for miles with oil from the bodies of the mutilated moss-bunkers.

It does not harm a fish to be deprived of its teeth as a new set will grow quickly and during its life they may be renewed many times. This applies, of course, only to those fishes which naturally possess teeth. There are species which never have any. A sucker and carp belong to this latter group.

Although man has been studying fishes for hundreds of years, it is surprising how little is known after all of their life history. Even most of their diseases are unknown, less than three dozen being described and most of these are of a pronounced character, as for example, the tail disease.

Pennsylvania has no salt water front, consequently all its fishes are either fresh water fishes or those which come into fresh water from the ocean to spawn; as for example the shad, herring, striped bass, white perch and common sturgeon. The total number of species indigenous and introduced, rare and common with the Com-

monwealth number 157. This number includes the different species of minnows and darters.

Among the introduced fishes are the small and large mouth black bass, the Atlantic salmon, the brown and California trout and the crappie.

At the session of the Legislature of 1901, a measure was enacted which definitely placed certain species of Pennsylvania fishes in two classes, game or food. It is believed that this is the first attempt of any legislature to specify particularly which are game and which are food fishes and so settle a vexed question. Unfortunately, the Legislature did not do its work thoroughly, for of the 157 species, less than three dozen are mentioned as either the game or food fishes.

The Legislature declared the following to be game fish: Salmon, brook trout, and all other fish belonging to the family of salmon or trout; black bass, green or Oswego bass; crappie, grass, or strawberry bass, white bass, rock bass, blue pike, pike-perch, Susquehanna salmon or wall-eyed pike, pike, pickerel, sunfish and muscalonge.

The food fishes were designated as follows: Shad, white fish, herring, lake herring, cisco herring, alewife, sturgeon, and striped bass or rock fish. Among the important fishes which were not regularly classified are to be found catfishes, the eel, the yellow perch, white perch and German carp. But while the Legislature failed to classify the last mentioned, it specifically designated means by which they might be caught lawfully. It is evident that apart from the yellow perch and the white perch, the Legislature deliberately left the catfish, eel, carp and sucker from the list of either class, because Section XXXI of the act of May 29, 1901, declares that nothing "shall prohibit the taking of any fish not specifically designated as game or food fish, at any time of the year, with rod, hook and line, or with hand line having not more than three hooks." The Legislature furthermore, apparently regarded the possibility of some of these fishes being at some time, of general usefulness, for in the same section it provided that the Fish Commission might at any time, by proclamation, declare a close season of three years for any of them, for purposes of natural propagation.

No attempt has ever been made to prepare a live exhibit of all the different species of fish found in Pennsylvania waters. The largest collection is undoubtedly that displayed at the Louisiana Purchase Exposition.

THE ATLANTIC SALMON.

With an ancestry extending back centuries into the misty past, the lordly salmon has ever been regarded as the king of fresh water fishes. And kingly he is, in size, proportions, beauty, strength and general habits of life. Poets, historians, scientists have all united in singing his praises. He is at home in many countries of Europe and America. Rich is he in relations but above them all he stands pre-eminent, "like a Scottish chieftain, needing no other name than that of his clan."

When in 1497, Cabot discovered Newfoundland, he also discovered that the salmon inhabited its waters. When also, in 1609, Hendrik Hudson discovered the river and lake which bear his name, he also claimed to have recognized the salmon in their waters. Certain it is that they were marvellously abundant in colonial times, for history relates how the epicurean palates of Connecticut apprentices revolted against salmon and shad as a diet more than twice in a week.

On the American side of the Atlantic, salmon are found from Labrador or Hudson Bay on the north to the vicinity of New York on the south. They have also been caught in the Delaware and Potomac rivers, some writers averring that the latter river marked the most southern limit for this specie of fish. Other writers claim that both the Hudson and Delaware rivers are or should be natural salmon rivers. It has been clearly demonstrated by experiments that the Delaware can be made a salmon river through artificial propagation.

The salmon, like some of the human progeny with grandfathers, inhabits two homes. He is born in fresh water, but "grows big" in his palatial residence, the ocean. Salmon can endure a wider range of temperature than some fishes, nor are they so sensitive to sudden changes. They enter the rivers twice during a year. It is generally conceded that the spring run of salmon is for the purpose of feeding on the young smolts and other species of the tribe, while the fall run is for spawning purposes. *

Though the salmon enter the rivers while the temperature rises they do not spawn until it falls. The most southern rivers are entered first, about April or May, while the most northern ones receive the later visits, sometimes as late as October. The spawning beds are usually established near the head waters of the streams.

As the spawning time approaches a great change is noticeable in the appearance of the fish. No longer neat and trim but lank and mis-shapen they become. The skin becomes slimy and thick

and the fins fleshy. Blotches of green or blue, brown, vermillion or scarlet supersede their usual bright colors. These changes are more apparent in the male than the female. His jaws become curved so that they close only at the tips, while the lower one develops quite a powerful hook. This hook, the salmon uses as a weapon with which to defend himself against rivals. In this condition and during the time of their return to the sea, the salmon are called "kelts."

The salmon make nests in which to deposit their eggs. These nests are deep furrows plowed up by the parents in the sandy or gravelly bed of the stream, usually near a rapid. The fish use their noses to shape the nests, although a land-locked salmon was observed excavating a nest by turning on her side and flopping against the bottom violently, with her tail. The male stood guard over her, driving away rivals and other foes. Each nest is filled with eggs before the next is begun, and each nest is covered with the sand loosened in making the next, it being carried chiefly by the current.

The spawning season begins about the middle of October and sometimes continues to December. The temperature of the water must be below 50 degrees F. The spawning is accomplished in installments, not all the eggs being deposited at one time, but usually requiring from five to twelve days for the performance of this function. The eggs are a bright salmon pink or salmon yellow color, about one-quarter of an inch in diameter. About 1,000 eggs to every pound of her weight are yielded by the salmon according to English authority while the Penobscot salmon average from 5,000 to 6,000 eggs for an eight pound fish and about 15,000 eggs for a forty pound fish.

Both the male and the female deposit their spawn simultaneously and the life of the young begins at once to develop. Owing to the cold waters and falling temperature, a period of five or six months is required for incubation. When about early May the baby salmon bursts from its shell, it has a slender, translucent trunk, less than an inch in length. Attached to this trunk is the large ovoid sac. The nourishment contained in this sac feeds the baby salmon for until it is absorbed into the system of the tiny fish, no other food is sought. About six weeks are required for this absorption and during that time the little creature lives in crevices among the stones using its pectoral fins as fans, ceaselessly.

When the sac is almost completely absorbed the little creature begins to look like a fish. Its skin becomes mottled and marked with bright red spots and several heavy dark bars across its sides. At this stage the young salmon is termed a "parr." At first the parr is about an inch long but it grows rapidly. The river at this season is filled with small insects and a variety of animalcule,

which the parr seizes with avidity and consumes with relish, for it has good teeth and a good appetite. In consequence, its weight is increased thirty or forty times during the first summer.

When the parr is two years old, it changes its mottled coat with its dark bars and red spots for the silver livery of the adult salmon. It is now about six or eight inches long. Then it is ready to see the world. It journeys to the sea with little delay, there to spend the next two years of its existence. During this period it is called a "smolt."

The exact time of the young salmon's departure for the sea has occasioned considerable dispute. According to the observations of Buist, it is claimed that in Scottish rivers some adopt the silvery coat at the close of one year and go to sea, while others of the same brood require two years for the change. American observations substantiate the conclusion that the young salmon spends two entire summers in fresh water and wend their way to the sea either the autumn or spring following the second summer. It is probable that this migratory period extends over many months, all of the young brood not being of equal growth and vigor and ready to depart together.

The smolt does not return until a weight of from two to six pounds has been reached, and he is about four and a half years old. Another name is accorded him at this period. He is now a "grilse." A "grilse" is an adolescent salmon. Its characteristics are very similar to those of the adult salmon, the principal differences being a shorter head, more slender form, and some differences in color and markings. The male grilse matures before the female.

While grilse ascend the rivers of Nova Scotia, New Brunswick and Canada in large numbers scarcely any are ever seen in the rivers of the United States. Unquestionably, the salmon in American waters pass through the same stages of growth and development as their northern kindred but in the grilse stage they lack the instinct which causes them to seek fresh water.

From the grilse to the adult salmon is the next step in the development of the life of this fish. Then it is that he first ascends the rivers of the United States. Christopher North gives a glowing description of the perfect salmon: "She has literally no head, but her snout is in her shoulders. That is the beauty of a fish, high and round shoulders, short waisted, no loins, but all body and not long of terminating—the shorter still the better—in a tail sharp and pointed as Diana's, when she is crescent in the sky."

In the lakes, minnows and other small fishes are food for the salmon. In the sea and in brackish waters, young crabs, small

shrimps, crustaceans and their eggs are the foods sought. When in fresh water they are supposed to eat but little, though they often show unmistakable appetites in their rushes after the angler's fly.

Salmon are wonderfully active and agile and their leaping powers are simply marvelous. Hear the poet's description of a leaping salmon:

"Here, when the laboring fish doth at the foot arrive,
 And knows that by his strength but vainly doth he strive,
 His tail takes in his teeth; and bending like a bow,
 That's to the compass drawn, aloft himself doth throw;
 Then springing with his tail, as doth a little wand
 That bended, end to end, and flirled from the hand.
 Far off itself doth cast; so doth the salmon vault,
 And if at first he fail, his second somersault
 He instantly assays, and from his nimble ring
 Still yesting, never leaves until himself he fling
 Above the streamful top of the surrounded heap."

THE TROUT AND CHARR.

The salmon is responsible for two great game fishes, the true trout and the charr, commonly called the brook or speckled trout. The first is scientifically known under the generic name of its great progenitor, the *Salmo*; the second, under the name of *Salvelinus*. According to Dr. Jordan the first had its origin in the glacial streams of Switzerland. The newly evolved fish began a northern travel, working up through Europe across Siberia to the Kamchatkan Straits, making slight changes on the way, thence across to Alaska working its way southwardly to the Sacramento Valley.

In Alaskan waters and for some distance south, it kept a uniform appearance and is known as the cut-throat trout, the name being derived from a V-shaped flash of crimson on the throat. Changes in environment brought about changes in form and character, until finally in the Sacramento Valley a distinct species became apparent known as the California or Rainbow trout.

Other scientific men assume that the charr had the same progenitor as the true trout, but first had its being somewhere in Great Britain. It took a northern course in Scotland and then worked through the Arctic waters to Greenland. From there it passed to Arctic America where it began a southern journey, passing through Labrador to the Dominion of Canada and entering the eastern United States, undergoing on the journey several marked changes.

Many people look upon the charr as a trout but there is one characteristic which clearly separates one from the other. A promi-

nent feature of the true trouts is, that they are black spotted, while the charr, as its name indicates, is crimson spotted. Those who have caught all forms and varieties of both families, place the charr or brook trout as a game and food fish, well in the lead.

THE BROOK TROUT.

In a river rushing over fallen tree trunks and brush, and through a tangled wilderness of growing trees and vegetation, in the crystal waters of a lake, in brooks of cold spring water nestling high upon the mountain side, in the foamy waters of a swiftly running stream or in the deep, quiet recesses of a more tranquil river, may be found a most graceful fish, the pet of nearly every angler. Like a coy maiden the brook trout must be wooed, both by her finny consort and the angler. She does not fall an easy prey to their wiles and it is only after the most assiduous attentions on the part of her mate and a skillful display of tactics on the part of the angler, what she is finally conquered.

To the Pilgrim Fathers, this member of the charrs, owes its name of trout. When they saw it in New England waters, they mistook it for the trout of their own streams in Devonshire and so designated it. The natural habitat of the brook trout is east of the Allegheny mountains and Great Lakes from the northern rivers of Georgia on the south northward to Labrador.

Local conditions, sex and age cause considerable variations in the color of the trout. From swiftly flowing streams brook trout with lithe, trim bodies, long and powerful fins are taken. Stout, short-finned fish are the product of quiet lakes, while limpid brooks in which the sunlight dances, and oxygen and stimulating food abound yield brook trout with transparent skin and vivid coloring. Somber in color and slimy are the trout living in dark, sluggish waters.

Trout love cool water and it must also be pure. Water polluted through any cause is always deserted by the trout. A temperature of 50 to 55 degrees suits them best, yet they live and prosper in water of 68 or 70 degrees if it like the Iser, runs rapidly and is foam tossed. When artificially hatched the brook trout can endure higher temperatures than when propagated naturally.

While trout are essentially fresh water fish they delight in excursions to the ocean. In the coldest months when the temperature is below 50 degrees the trout around Long Island live in the ocean, while the trout found north of the Bay of Fundy seek the ocean in mid-summer. With no access to the sea, trout inhabit different parts of their native streams at different seasons of the year. The bottoms of cool lakes, the channels of streams, and hiding places behind rocks in deep pools, are the spots sought in mid-summer. In

spring and early summer the rapids are their abiding places while the autumn weather with its increasing cold drives the trout to the shallow waters near the sources of streams.

The brook trout is a carnivorous fish and a cannibal. Its appetite is keen, except during the spawning season. Worms washed from the banks are its favorite food, but water insects, colored flies, crustacea, tiny fishes all become its prey and when driven by hunger, its love of kindred does not prevent it from devouring the young of its own specie. Artificially reared trout are fed on the liver, heart and lungs of animals killed for food.

Nests are built by the trout in which to deposit their eggs. The mother-fish fashions the nest in the gravel at the heads of streams, fanning out small particles of matter with her tail and carrying out larger ones in her mouth. When the nest is ready the eggs are laid and covered with gravel and a new nest begun. This process is repeated until all the eggs are laid. A period varying from 35 to 165 days, according to the temperature of the water, is required to incubate them. The colder the water, the longer the time required.

Three-sixteenths of an inch in diameter is the usual size of trout eggs although this varies as does the color. A dull orange or reddish tint is the ordinary hue. The little fish are born with the yolk-sac attached to them. The nourishment contained in this sac sustains the tiny creature until it is entirely absorbed. From thirty to eighty days are required for this process of absorption. The number of eggs varies with the size and age of the trout, two-year-olds yielding from 350 to 500 eggs and older and larger trout from 500 to 2,500.

From October until about February is the spawning time of the brook trout in this locality. In the territory around Lake Superior it begins oftentimes as early as late August. Upon the character of the stream and the food supply depends the size of the brook trout. In small streams, fish weighing but two or three ounces and but six or eight inches long may be mature. In larger bodies of water where food is more plentiful fish eighteen inches long and sometimes longer, weighing several pounds, are caught. All two-year-old trout and occasionally yearlings are sufficiently mature to reproduce their specie.

From a commercial standpoint the brook trout are not of the greatest importance, but they have ever been prime favorites with the fish culturist and the angler. Dr. Garlick and Prof. Ackley who introduced the work of fish culture in America, chose the brook trout for their experiments. The game attributes of the fish are of such an order as to give it first place with the large majority of anglers. As a food it is considered a great delicacy.

In Pennsylvania, millions of brook trout are annually propagated, artificially, and distributed in the various trout streams of the Commonwealth.

LAKE TROUT.

Environment stamps in indelible characters her marks upon the personality of most living things. Whether her subject be of high or low estate, the effects of her handiwork are distinctly traceable. Among the members of the finny tribe, the lake trout is a notable example of the effects of environment.

Indigenous to North America the lake trout inhabits all of the Great Lakes as well as many of the inland lakes of northern Maine, New Hampshire and New York. In Canada, the region around Hudson Bay, Labrador, parts of Alaska, the vicinity of the head waters of the Columbia river, the lake trout may also be found as native. In none of these places is the lake trout found exactly alike. Different variations mark nearly every place, nor is this strange when all things are considered.

The lake trout is the closest relative of the lovely speckled brook trout. Strange as it may seem, it is an evolution from the latter fish produced by changed environments. The differences in the size, appearance and habits of the two fishes may be more readily understood when the differences in their food and natural haunts are considered. In comparison with the brook trout the lake trout lives in a restricted area, in a much deeper and much greater volume of water. The food supply is different, too. Instead of the insects, worms and tiny animalcules eaten by the brook trout, various kinds of fishes and other offals into the lakes are the food of the lake trout. The vast difference in the size of these fishes is the result of these conditions.

Several explanations are advanced for the variations in the lake trout found in different bodies of water. The several Great Lakes, as well as the numerous inland lakes, are practically independent bodies of water, so far as fish life is concerned. Whenever several of a specie of fish become isolated, time almost invariably produces a change or variation in the structure or appearance, which if continued sufficiently often may in time evolve an entirely new species. Each body of water not only contains a food supply peculiar to itself, but the character of the lake beds and the waters themselves differ. Then, too, the fundamental principle of evolution plays an important part—the survival of the fittest.

Because of these reasons it would be difficult to find exactly the same variety of lake trout in any two lakes. Some are almost black, they are so dark. Others are gray with markings similar to

a pickerel's. Some have vivid crimson spots and others are conspicuous by their absence. A difference in form is also observable but despite these variations ichthyologists declare that they represent but one distinct specie, the *Chistivomer namaycush*.

The lake trout has a ravenous appetite and in catering to it exhibits some of the propensities of the goat. It will devour greedily fish almost as large as itself while an analysis of the contents of its stomach, after being caught, will reveal such indigestible articles as jack-knives, corn cobs and similar materials. Because of its voracious appetite, fishermen were at first opposed to its artificial propagation, fearing that the very desirable white fish would constitute its chief food, but as the lake trout repair to deep water immediately after spawning and the young white fish inhabit the shallows, the fallacy of this belief is generally admitted and the objections were withdrawn. Lake trout are annually hatched and distributed from the Erie Station.

From the latter part of September in Lake Superior to November and early December in the other Great Lakes, is the spawning time of the lake trout. The "honeycombed" rocks, ten to fifteen miles from the shore and at a depth of from one to twenty fathoms, are the spawning grounds. Because of the shyness of the trout, the depth of the water in which she spawns and unpropitious weather, much data has never been collected regarding the habits of the fish at this period. Comparatively, the lake trout does not produce a large number of eggs, from 5,000 to 6,000 being the usual allowance although a 24 pound fish did produce 14,493 eggs.

As a game fish the lake trout has been both vilified and extolled. His great weight and his habit of living in deep water necessitate heavier and clumsier fishing tackle to effect his capture than is usually enjoyed by the sportsman angler. Other experts, notably Mr. A. N. Cheney, distinctly classes the lake trout as a game fish.

From a commercial stand point the lake trout is very valuable. It is a good food fish and the trout fisheries of the Great Lakes rank next in importance to the herring and white fish industries.

In regard to the lake trout many curious superstitions exist among some of the fishermen. For instance, they contend that the offal of the lake trout should never be fed to hogs, for such a meal would cause the hogs to become, first crazy and then die. The liver of the fish is supposed to be a virulent poison to man causing, if not death, an illness requiring many months from which to recover.

THE BROWN TROUT.

In 1883, Herr Von Behr, late President of Deutscher Fischerei Verein, introduced into the United States from Germany, a food and

game fish known as the brown trout, sometimes called the von Behr trout, in honor of its introducer. It is a famous fish, for its praises have been sung for centuries by poet and prose writer alike, every phase of its beauty, its movements, and various other qualities constituting themes upon which to expatiate. Indeed, the writings of Isaak Walton alone would have made the brown trout famous.

Its natural habitat are the various lakes and streams of Continental Europe, where it thrives in numerous latitudes and elevations. In New Zealand, where it has also been introduced it thrives well, reaching an average weight of ten to eleven pounds and in some instances attaining a weight of twenty-two pounds and a length of thirty-five inches. In the United States the brown trout has made itself thoroughly at home and under favorable conditions, grown with wonderful rapidity. It has been known to weigh fourteen or fifteen pounds in this country, although these are not average figures.

Planted in pure, cold water containing an abundance of food, the brown trout develops almost as rapidly as the German carp. When planted in shallow waters, with a less abundant food supply, or the food being principally insects, the arrested growth is as wonderful, as in the other case, it was marvelous. The brown trout is a striking illustration of the effects of food and water upon development.

October is the beginning of the spawning season and this function continues through November and December and sometimes into January. The brown trout, at times build nests for their spawn, and frequently deposit it in crevices between stones or under the roots of projecting trees. It requires many days for the female to deposit her eggs, the process being continued at intervals and not uninterruptedly. After the eggs are deposited they are partly covered with gravel by both the parents.

In color, the eggs are yellowish or reddish. In size, they vary from one-sixth to one-fifth of an inch in diameter. From forty to seventy days are required, according to the temperature of the water, to hatch these eggs. In a temperature of about 50 degrees F. the young fish thrive and it is said not to be unusual for them to attain a size large enough to catch, one year after they are spawned. They have also been known to reach a spawning age in two years.

The brown trout is quite desirable as a food. Its flesh is nutritious and easily digested. In color, it is a deeper red than the flesh of the salmon. Food and locality, however, causes variations in the color and flavor of the meat. From May until the last of September is the time the brown trout is in its prime.

This distant relation of the American brook trout has secured for

itself a host of friends and as many enemies. Its splendid game qualities must ever cause admiration and afford fine sport to the angler. On the other hand, its voracious appetite, its marvelous growth, its well-developed cannibalism, and its insatiable appetite for fish spawn, cause its enemies to fear its baneful effects on the Queen of American waters, the beautiful speckled brook trout. It is sufficient to add that even the friends of the brown trout deem it advisable to distribute it in waters destitute of the brook trout and thus guard against any injury it might cause by its well-known habits.

RAINBOW OR CALIFORNIA TROUT.

In the mountain streams of the western slope of the Sierra Nevadas and the Pacific Coast Ranges, lives a fish celebrated for its beauty of form and color, its graceful and sprightly movements. The adult fish has a bluish back, silvery sides, a red lateral band, the back and sides being dotted irregularly and profusely with dark spots. It is called the *Salmo iridius* or rainbow trout.

According to Dr. Jordan, the typical rainbow or California trout is found only in the small brooks of the Coast mountains in California, but there are a number of varieties found in the Pacific states. Descended from the lordly salmon, the original members of the trout family were born in Europe in waters of glacial origin. Possessing the roving natures of some of the adventurers and discoverers of old, the trout, too, seemed to search for fresh fields and adventures. In the course of their migrations some reached Alaskan waters, somewhat altered in characteristics as a result of changed environments. These were familiarly known as the cut-throat trout, because of the V shaped blotches of scarlet on the throat.

In turn some of this variety reached the Columbia river and its tributaries where they settled and reproduced their kind. So long as the sea was accessible their descendants retained the characteristics of their Alaskan kin, but when as a result of glacial action, a number were imprisoned in the Waha Lake, Washington, the characteristics of their progeny changed and evolved a new variety, called *Salmo Mykiss Bouvierii*. Others of the original cut-throat variety emigrated to the Platte river, other again, to the Colorado Basin and other places in the vicinity, each in turn developing new characteristics.

Still another group of descendants of the Alaskan colony wended its way to the Sacramento river and in due time there resulted a variety possessing larger scales and a more pronounced color. This is the variety already described as the *Salmo ireidius* or rainbow trout.

The rainbow or California trout spawn in winter and early spring. The average yield of a fish is about 900 eggs. Worms, insect larvae, crustacea and salmon eggs are the foods sought by the rainbow trout. Unlike the brook trout this variety does not care for minnows as food. With the proper conditions in regard to volume of water, temperature and food, the rainbow trout develops rapidly. The average weight is from one to three pounds, although they have attained a weight of from three to ten pounds.

The beauty and fine game qualities of this trout early attracted the attention of the authorities and it was decided to introduce it to Pennsylvania waters. The first plantings were not crowned with success. Having in mind the general climate of California, the natural habitat of the rainbow trout, the idea prevailed that they would thrive in waters of a much higher temperature than the brook trout, and plantings were made in accordance with this idea.

This was afterwards discovered to be a grave error. In point of fact the rainbow trout requires even colder water than the brook trout of the east, for while it is true that the streams they inhabit are in a warmer, balmy climate, the waters themselves are from sources of perpetual ice and snow. It has since been ascertained also, that while the rainbow trout is a delectable table food and possesses game qualities of a high order, it does not reproduce naturally in Pennsylvania waters.

SMALL AND LARGE MOUTH BASS.

Among anglers there is a great difference of opinion concerning the game qualities of the trout and the black bass. The great majority concedes the superiority to the trout, but there is a great multitude who enthusiastically acclaim the sovereignty of the black bass. There is a third group of anglers who hold that the two fishes rule jointly; that the play of a trout is like that of a scientific boxer sparring for points, while the struggle of the black bass with the anglers is like the fighting of a savage.

There are two distinct types of black bass, one known as the small mouth and the other as the large mouth bass. The first is smaller than the second, but far superior both in game and table qualities. The first loves swift flowing water and rocky places, and the second prefers sluggish water and muddy bottoms.

The original habitat of the black bass is very extensive, according to Dr. Henshall, embracing the whole of North America south of the British possessions and east of the Rocky mountains, excepting the waters of the New England and Middle states. The large mouth bass had the widest distribution, being indigenous to the

waters of all this territory, while the small mouth specie had a more limited range, the Alleghenies forming the eastern and southern extent. From their original habitat both have been transplanted into all the waters of the Middle states and New England. While both species of bass are common to nearly all waters, the small mouth variety is more extensive towards the north and the large mouth towards the south.

To a number of enthusiastic anglers of Easton and Philadelphia, headed by Mr. Thaddeus Norris, the eminent fish culturist, is due the introduction of the black bass to Pennsylvania waters. The work accomplished by these gentlemen has been detailed in a previous chapter of this pamphlet. Black bass adopt new homes kindly, and their great fecundity causes them to multiply rapidly wherever introduced.

Small and large mouth black bass are readily distinguished one from the other. One of the differences easily recognized is the comparative size of the mouth. In the small mouth bass the angle of the mouth is on a direct line with the eye, while in the large mouth bass it extends considerably beyond the eye. The scales on the cheeks of the bass are another easy means of identification. In the first named species the scales on the cheeks are smaller, with a greater number of rows, while in the second named variety, these scales are much larger with a lesser number of rows.

Except in the warmer waters of the south, there is no question that both species hibernate. In the cold waters of the north, these fish seek the deepest waters and burying themselves in the crevices of rocks, under weeds, or sunken logs, or in the mud, lie dormant until the approach of spring.

When spring and spawning time approaches, the bass leave the deep waters and in large numbers wend their way up the various streams, males and females forming in pairs. Places in the gravelly or sandy beds of the streams, or on rocky ledges in the water, are selected by the small mouth bass, and nests constructed. These nests are saucer-like depressions from one to three feet wide. The fish use their fins and tails to fan and remove from the pebbles in the nest all debris, larger obstacles being removed with the mouth. The clean pebbles in these gravelly nests produce a bright, white effect.

Other nests are constructed presumably by the large mouth bass in the muddy bottoms of streams and lined with leaves and small sticks which have been thoroughly cleaned by the fish. In these two kinds of nests the eggs are deposited and assiduously guarded by the parent fish.

Locality and the temperature of water determine largely the time of spawning. In the extreme south eggs are deposited as early as

April, while in the colder north this function may be delayed until July.

About eight or ten days and sometimes two weeks are required for the eggs to hatch. The newly hatched fish vary from one-fourth to a half inch in length and are nearly perfectly formed. They remain in the nests for several days, during which time the parents teach the little ones to eat and guard them against all foes.

After leaving the nest, these little creatures feed on the eggs of other fishes, animalculae, larvae and tiny insects. When they grow larger, worms, tadpoles and small fish become their prey and when reaching maturity they unceremoniously gobble anything from a worm to a young muskrat. Despite the fact that the parents guard the nests so lovingly, it is said that after the little fishes leave them, the parents forget the ties of blood and their offspring often become their prey, while larger brothers and sisters, emulating their parents, contentedly devour their smaller ones.

The bass mature in from two to three years. Small mouth bass in the north and west reach a maximum weight of four or five pounds, while the large mouth variety weighs from six to eight. In the south, both species grow much larger. The food supply, the temperature, and the extent of the body of water they inhabit, all affect the growth. Bass in ponds or in shallow lakes do not thrive as well, or grow as large as the bass in deep and large bodies of water.

Both species of the black bass vary in color. Young small mouth bass are light green, reflecting golden tints, while the large mouth are dark green with a blackish band along the sides and clusters of dark spots. When first caught fishes of the same specie often exhibit differences of color, but after subjecting them to the same conditions for a few hours, they will all become the same color.

The coloration of fishes is frequently affected by changes in conditions in the character, depth and temperature of the water. Fresh and salt water also affect the coloring. For instance, a brook trout which sojourns in the ocean, acquires the silvery appearance natural to marine fishes, but when it returns to fresh water it soon resumes the coloring of the trout again. The colorations in the livery of fishes are due to the pigment cells contained in one or both layers of the skin. These cells are controlled by the nervous system and are influenced by it and environment.

Bass fishing furnishes sport for multitudes of anglers. To reach salmon and trout streams frequently requires an amount of time and money not at the disposal of the army of sportsmen, while owing to the extensive habitat, both original and adopted, of the bass, many of the disciples of the gentle Izaak Walton can indulge their proclivities for this art, who would otherwise be denied the pleasure.

ROCK BASS.

Scientists delight to dignify even the most ordinary things of this world with not only high sounding titles but those which require a constant reference to dictionary and key to interpret. There is a fish found in many streams of Pennsylvania and elsewhere which these learned men call *Ambloplites rupestris* of the genus *Rufinesque*. Many young people know this fish also but not by its learned title. They call it rock bass or red eye or goggle eye. Not nearly so learned a name, we admit, but much more intelligible to ordinary mortals.

There is a reason for this name red eye, or goggle eye, and one which does not require a dictionary for interpretation. The rock bass has two deep crimson spots on each eye, hence the name. These spots besides furnishing a name also provide a means of positive identification from the black bass, for the rock bass is not only related to the black bass but also resembles him in some respects. So does the rock bass resemble a sunfish. The rock bass is shaped much like the sunfish and is colored much like the black bass. However there are many points of difference which are recognized even by the young and comparatively inexperienced fishermen.

From Canada, through some of the lakes of New York, and the Great Lakes, down through the Ohio and Mississippi Valleys to Texas, is the natural habitat of the rock bass, but it is at home in Pennsylvania waters also, although just when and by whom it was first introduced, is not positively known. It is a delightful acquisition nevertheless for it is a toothsome fish and one which can be hooked successful by various classes of fishermen, expert or inexperienced, young or old, male or female.

Rock bass are game, also and are not despised by the trout and black bass angler. They will rise to an artificial fly with as much avidity as to natural bait and when hooked fight with cunning and energy for a time. The flesh is white, firm and quite toothsome.

This fish is a nest-builder also. When the spawning season arrives in May and June the rock bass constructs a nest in a gravel bed, if in a swiftly running stream, or on a bar, if the water is a lake, and there deposits her eggs. The nest and its contents are vigorously guarded and defended by the parents. Larvae of insects, worms and crustaceans are eaten by the rock bass early in the season. Later, crawfish and minnows are food for the species. Insects and their larvae are the food of the young.

Rock bass do not attain the size of the black bass yet they grow much larger than the sunfish. A fourteen inch length and two

pound weight have been reached, but this is not usual. Less than a pound is the weight of the average fish. Clear, cool waters not too swift are the kind it prefers and it will always be found in the quiet water of deep holes in streams in which there are large boulders or old logs and water plants.

In traveling it is not exclusive like the black bass, its cousins, but travels in large schools. For this reason, the rock bass fisherman will usually have a larger string of fish to show than he who would have nothing but black bass on his line. From Memorial Day to the end of December is the proper season for rock bass fishing and the law will permit the capture of any specimen over five inches in length.

CALICO OR STRAWBERRY BASS.

The success achieved by the Commission in introducing black bass to the waters of Pennsylvania caused that body to decide to experiment with other fishes not indigenous to the Commonwealth, and the calico or strawberry bass was early singled out for a trial. The first calico bass were obtained from the vicinity of Newark, Ohio, at the Licking reservoir and planted in the Susquehanna river near Harrisburg. This was about 1876. A couple of years later 2,000 more were sent from Ohio and planted in the Juniata river, near Hollidaysburg, in the Monongahela, at Pittsburg, and the Lehigh, and Susquehanna, near Harrisburg. At present the calico bass is not well known outside of the Lake Erie and part of the Susquehanna river regions, in Pennsylvania.

Outside of Pennsylvania, the calico bass is well known throughout the region of the Great Lakes and the Upper Mississippi Valley. It is also indigenous to waters as far south as Texas and New Jersey. It has also been introduced into France with success.

With its gorgeous livery the calico bass is a dangerous rival of the common sunfish, in matters of raiment. Its back is olive green, its sides yellowish, thickly spotted with olive, both back and sides reflecting silvery hues. Its fins, too, are beautifully colored and mottled and altogether the calico bass is a captivating beauty. A lavish vocabulary of names is also its portion, it answering to the call of strawberry bass, grass bass, green bass, Lake Erie bass, Lake Croppy, and various other local epithets.

Deep, sluggish waters are its native haunts, but it can readily accommodate itself to cold, rapid streams as well as small brooks. These bass travel in schools. They feed upon small crustaceans, worms and fishes. They are not predaceous and their stiff spines protect them from enemies.

Spring is the spawning time of the calico bass. It is considered a rapid breeder and for this reason as well as for the ease with which it adapts itself to new waters, it is considered by many fish culturists as the coming fish. Its food and game attributes also recommend it. As a pan fish it is counted among the best and its high game qualities appeal to the angler. It will rise to an artificial fly as well as live bait. Around stumps or fallen trees, in deep, dark water is a good place to go with a line.

Calico bass in some localities have reached a length of fourteen inches and a weight of three pounds but this is not usual. The average length is from ten to twelve inches and the weight from one-half to one pound. Fish culturists consider the calico bass a most desirable species to introduce into the various rivers as well as strongly recommending it to farmers for pond culture.

WHITE BASS.

Within the limits of Pennsylvania, white bass is found only in Lake Erie and the tributaries of the Ohio river. Outside of the Keystone State it is found in abundance in the Great Lakes and in the Mississippi Valley as far south as the Ouachita river in Arkansas. The white bass greatly resembles the striped bass and the identity of the two are frequently confounded. The scales of the white bass are larger and there are fewer rows than in the striped bass.

Although the white bass is a game fish and furnishes good sport to the angler, it is a quiet, gentle fish, unobtrusive in its movements and not disposed to participate prominently in the affairs of life. It is a beautiful fish with its glistening silvery sides, reflecting a golden glory and adorned with blackish, longitudinal stripes. It is from twelve to eighteen inches long and varies in weight from one to three pounds.

Still, deep water is its favorite abiding place. Muddy or weedy waters are its aversion. The white bass possesses the characteristics of most of its relatives in regard to spawning. When that season arrives it leaves the deeper water and travels shoreward to deposit its eggs. May and June are the usual months for this function.

Minnows, crustaceans, tiny mollusks are the favorite foods of the white bass. It is an excellent food fish itself, being considered nearly as good as the black bass. Compared with the black bass, it is not so voracious and its game qualities are not of such a high order, yet it is a favorite fish with many anglers.

THE SUNFISH.

What delightful reminiscences the sunfish must bring in its wake. Happy days spent in the country beside a pond, a brook or little stream with a rod and line, most likely an improvised one, and a lunch box. Blue skies overhead, green meadows and trees, flowers, butterflies, and birds singing and twittering everywhere. Bare-foot boys, careless and happy—with an old tin can full of worms, beside them, busily engaged baiting hooks and casting them in the stream. Should you ask what they are after, it is more than likely the reply will be, "Sunnies." They will smile at you, too, in their superior wisdom, wondering why you had to ask such a question.

That the sunfish has developed many anglers there can be no question. The pleasurable sensations experienced by the boyish fisherman when he lands his first sunfish, actuates him to try again and a little later to test his skill with higher game. While not of the highest order, the sunfish belong to the class termed game fishes. Any bait mostly, will tempt the sunfish and he will rise to an artificial fly in the same manner as a brook trout. When hooked he will struggle fiercely to regain his liberty but his struggle in this direction are usually in vain.

In nearly all waters the sunfish is to be found. And it matters not whether he is sought in deep or shallow water, in quiet pools or swift currents, in eddies or back water. Wherever there is a chance for food, there will the sunfish be, for he is a very greedy fellow with an insatiable appetite.

Few fishes are more prolific than the sunfish and unlike some other members of the finny tribe these members of the perch family make good parents. When the spawning time approaches, the sunfish seeks a shallow place where the water is warmest and then proceeds to build a nest. Both the male and the female engage in this work. With their fins they fan away the mud until they reach clean gravel. Then with their heads and mouths they remove stones, sticks and other debris; piling them up around the nest until it is surrounded by a little ridge. The nest varies in size from one to two feet.

After the nest is completed, the eggs are deposited in it and fertilized. Then the parents take turns in watching the eggs. The nest is never left alone, one parent always on guard, hovering over the nest and acting much like a fussy hen over her chicks. Should anything drop in the nest, the sunfish removes it at once. While on guard the fish never eats. At this time it is most cruel to cast a line over the nest for the parent fish will seize the bait, not to eat, but to remove from the nest lest it harm the eggs.

The pugnacious qualities of the sunfish are more strongly manifest during the spawning season than at any other time. Despite the discrepancy in size, even a German carp, a most voracious spawn eater, will hesitate to attack a sunfish while guarding her nest. A very short time is required to hatch the eggs and after they are hatched the parents guard the tiny fish as carefully and jealously as they did the eggs, until they are old enough to care for themselves.

There are many varieties of this species of fish but the three best known in Pennsylvania waters are the common sunfish, the long eared sunfish and the blue or Lake Erie sunfish.

Longfellow has immortalized the sunfish in his beautiful poem, "Hiawatha." It is rather a coincidence that not only is the sunfish one of the first known to the boy angler, but the poem itself is early known and deeply appreciated by that same boy:

"Slowly upward, wavering, gleaming
 Rose the Ugndwash, the sunfish;
 Seized the line of Hiawatha,
 Swung with all his weight upon it.
 But when Hiawatha saw him
 Slowly rising through the water,
 Lifting up his disc refulgent,
 Loud he shouted in derision
 'Esa! esa! shame upon you,
 You are Ugndwash, the sunfish;
 You are not the fish I wanted;
 You are not the king of fishes.'"

—Longfellow.

LAKE ERIE OR BLUE SUNFISH.

Of all the sunfishes, the blue or Lake Erie sunfish is the most important both as a food and game fish. It is the sunfish of the lakes. Indigenous to Lake Erie it has been extensively and successfully transplanted to many other waters of Pennsylvania. The blue sunfish is found in all the Great Lakes and in many small ones. It is more widely distributed than most species of sunfish and may be found in the streams within the Mississippi Valley from Western Pennsylvania and New York to Missouri and Iowa, and from Minnesota to Florida.

The blue or Lake Erie sunfish grow to a length of twelve or fourteen inches and a weight of nearly two pounds, although eight inches is the usual length and less than a pound the average weight of the adult. Its color varies from light to dark green. The young fish have silvery sides with vertical greenish bands. It is an ex-

cellent pan fish. Its flesh is firm, flaky and of fine flavor and it is the variety most frequently sent to market where it commands a good price.

THE COMMON OR "PUMPKIN-SEED" SUNFISH.

A fish nearly oval in shape and brilliant in coloring, found in nearly all rivers and streams, briefly describes the sunfish best known to the boy anglers. This is the common or river sunfish, otherwise known as the "punkin-seed," "tobacco box," and "sunny." This sunfish has a greenish-olive back shaded with a bluish tinge. Its sides are spotted and blotched with orange. The belly is orange-yellow. The cheek is orange with wavy blue streaks. The fins are bluish with orange spots and the opercular flap is black margined behind and underneath with bright scarlet.

The common sunfish is found everywhere in Pennsylvania and also westward from Maine to Minnesota through the Great Lake region, and in the Atlantic States from Maine to South Carolina. The largest grow to be eight inches long and a half pound in weight although the average size of those caught is less than these dimensions. Its flesh is of good quality and in some places is a valuable article of food.

It may be lured with a great variety of baits and most any sort of tackle but the greatest sport is enjoyed when the fisherman uses a very light rod and an artificial fly. Although this fish is "gamey" it must be remembered that he is small and of light weight and therefore heavy tackle will destroy the sport in catching him.

LONG-EARED SUNFISH.

This sunfish is extremely variable in color and form and is known under a variety of common names; as, bream, red-tailed bream, red-head bream, red-bellied bream, perch, sun-perch, red-bellied perch, and red breast. It is always one of the brightest colored of the fresh-water fishes.

It has an extensive habitat being common in the streams east of the Alleghenies from Maine to Florida and in the Gulf States. It is also abundant in the Susquehanna and Delaware rivers, reaching a large size in the latter river. The long-eared sunfish favors coast streams rather than those in the interior. In the south it increases in size and numbers and is rather important as a food fish.

Worms, insects, larvæ, mollusks, crustaceans, and small fishes are its prey. It spawns in early summer.

STRIPED BASS OR ROCK FISH.

Despite the fact that some historians impeach the veracity of Capt. John Smith, nevertheless an extract from a letter written by the brave captain to some friends in England, will give a fairly accurate conception of the vast numbers of striped bass found in America by the early colonists: "The Basse, wrote Captain John Smith, "is an excellent fish, both fresh and salte, one hundred where of salted (at market) have yielded five pounds. They are so large, the head of one will give a good eater a dinner, and for daintiness of diet they excell the Marybones of beefe. There are such multitudes that I have seene stopped in the river close adjoining to my house with a sande at one tide so many as will loade a ship of 100 tonnes. I myselfe, at the turning of the tyde have seene such multitudes passe out of a pounce that it seemed to me that one might go over their backs drishod." However many interrogation points may be required in connection with Capt. Smith's ordinary narratives, his story of the striped bass has been corroborated by a reverend gentleman, his contemporary, who wrote the following letter regarding this fish: "There is a fish called a basse, a most sweet and wholesome fish as ever I did eat; it is altogether as good as our fresh sammon and the season of their comming was begun when we came first to New England in June and so continued about three months space. Of this fish our fishers take many hundreds together, which I have seene lying on the shore to my admiration; yea, their netts ordinarily take more than they are able to hall to land."

As still further proof of the abundancy of the striped bass the following records are most interesting: On May 6, 1896, 38,000 pounds of this fish were landed at one haul. Six hundred of them averaged sixty pounds each and a few weighed 105 pounds each. Even though it is a well known fact that there has been a decrease in the early abundance, the catch on the Atlantic Coast for 1897, aggregated nearly one and one-half million pounds, the value of which was \$128,000.

So much for the abundance of the specie but there are other interesting facts pertaining to it. The striped bass is indigenous to the Atlantic Coast from the Gulf of St. Lawrence to the Gulf of Mexico. It spends much time in the sea, although it lives with equal ease in brackish or fresh water. It usually spawns in the rivers although sometimes the eggs are deposited in brackish or salt water near the ocean.

From April to June is the spawning season. The eggs are about one-seventh of an inch in diameter, and are semi-buoyant and transparent. A very large oil-globule is attached to each egg. If placed

in a jar or receptacle in still water, they gradually sink to the bottom but the slightest movement of the water causes them to rise and remain suspended for some little time. When hatched the "sac" remains attached to the tiny creature which nourishes it but as soon as the sac is absorbed, the wee fish turns cannibal and preys on other fishes. Minnows and young shad are special victims of its voraciousness.

Dr. C. C. Abbott relates the story of their greed and voracity as follows: "A rock fish (striped bass) will frequently 'corner up' a small school of minnows, and then pick them up as rapidly and with as great ease as a fowl will pick grains of corn; and while devouring the luckless minnows, will keep them in a small space, close together all the time. There is no cessation of this murderous work while a fish remains, for after devouring all that it is possible for him to hold, a mere love of destruction keeps him at work. I once had a very favorable opportunity of watching the rock-fish feed in this way. It was a moderate sized fish, about a foot long, and as near as I could determine it devoured a dozen "cyprinelles (silver finned minnows) in four minutes. If less in my estimate it is on the safe side, and it may be it was fifteen minnows in that length of time. I subsequently captured a dozen of these pretty shiners and I found I could by no means squeeze them into a bulk that was not much larger than the estimated interior of a rock-fish a foot in length; and yet it is certain that the minnows captured by the rock fish were swallowed without decapitation or other reduction in size, for in that case I should have seen the fragments of the minnows floating in the clear waters."

Striped bass grow with wonderful rapidity. From measurements made by Dr. Abbott it has been ascertained that fry measuring an inch in June, were four and a half inches by the middle of October. Large numbers of young fry from five to nine inches are caught in the Potomac river in February and March. These are believed to be the fry hatched the previous summer or fall. During the first year a striped bass frequently attains a weight of five or six pounds. The average weight of the rock fish does not exceed twenty pounds, although various weights to and beyond the hundred weight have been recorded.

Commercially, the striped bass is quite valuable. As a food fish it ranks among the best and ready purchasers are found for it in the markets. Unlike, the black bass, its cousin, this fish can be propagated artificially. A peculiarity of this specie, of special interest to the ichthyologist, is the ease with which a hybrid may be produced with a fish of an entirely different genus. Experiments in this direction have been made with the shad and the striped bass.

As a game fish the striped bass is a dangerous rival of the brook

trout and the black bass. Each has its angling friends claiming for it supremacy. Certain it is that the angler for striped bass must possess a cunning of both mind and hand to match the cunning and alertness of his adversary and strong must be his tackle to withstand his onslaughts.

In the north, striped bass is the favorite appellation of this fish, while in the south it is termed rock fish or the "rock." Books have been written in praise of it and among anglers, ichthyologists, and writers on piscatorial subjects, the striped bass has shared the fame of the lordly salmon, the black bass and the lovely speckled trout.

YELLOW PERCH.

The yellow perch is an aristocratic fish. Were it a human being it would be deemed worthy of admission to the most exclusive circles in Philadelphia south of Market street. It is one of the few fishes which flourished during the Devonian Period and has survived all the succeeding ages to the present time without change of form or characteristics.

It is found almost everywhere in Europe and has an equally wide range in America. All along the Atlantic slope from Labrador to Georgia, in the region of the Great Lakes, in many parts of the Mississippi Valley, the waters are full of yellow perch, also called in Philadelphia and vicinity by the more familiar title "the yellow ned."

A handsome fish is the yellow perch, with its beautiful colors and graceful movements. The beauty of its golden yellow sides and dark greenish back is accentuated by the blackish bands extending across its body while the ruddy lights reflected by its brilliant orange or red lower fins glorifies the harmony of the whole color scheme.

While not a game fish of the highest order, the yellow perch possesses sufficient fighting qualities to enable it to be ranked in this class of fishes. The short, savage struggle it makes to free itself when hooked, plainly demonstrates that it possesses some of the fighting blood of its cousins, the black and the striped bass.

As a food, it is ranked as one of the best pan-fishes among the American varieties, and a ready market is always found for it. The flesh is sweet and wholesome, although coarser than that of bass and sunfish. It is said to be at its best during the spawning season. The spawn of the yellow perch is considered by some writers to be very delicate and nourishing.

The yellow perch is not a great traveler. Indeed he may be termed a home-loving soul as he displays little inclination to move far from his birthplace. The yellow perch and the sunfish, another relative, are usually found together. Whether this is due to a par-

tiality for each others society or to a liking for the same kind of water is a question not to be answered with positiveness, but the latter reason is probably the right solution of the question.

Ten inches is the usual length and a pound or less, the average weight of the yellow perch, although a greater length and weight are attained by the species. Late winter and early spring are the spawning times of this fish, the water temperature varying from 45 degrees to 49 degrees F. The eggs are one-thirteenth of an inch in diameter and it requires about 28,000 of them to fill a quart measure. The fish is very prolific, various estimates being placed upon the number of eggs spawned, some authorities quoting 127,240 eggs from a fish weighing two pounds eleven ounces, and 155,620 eggs from a fish of three pounds two ounces. Block credits 28,000 eggs to an average yellow perch and Dr. Abbott places the number at 8,000.

Soon after fecundation the eggs expand and grow much heavier, the spawn often exceeding in weight that of the fish before the spawn was deposited. The eggs are hatched out in about a week or ten days.

Owing to the generally fair supply of this specie, artificial propagation has never been undertaken in the fullest sense of the word, but the fish are impounded at some of the hatcheries and the eggs which have been naturally spawned and fertilized, are artificially hatched in aquariums and ponds specially constructed for this purpose.

Opportunity is thus given to observe the development of the most remarkable spawn known. Instead of the eggs being extruded singly, in little streams, as in the case generally, the spawn of the yellow perch is one piece. In shape it is long and ribbon-like, one end wider than the other, the whole arranged in fluted folds, resembling the sides of a bellows or accordion. This ribbon-like string is very long, measuring from two to sometimes more than seven feet, according to the size of the fish. It is a translucent, light grayish or yellowish mass, strongly reminding one of a piece of rare and delicate old lace.

Holding the eggs in place is a delicate membrane forming the walls of this wonderful structure. Between the walls, back and front, so to speak, runs a cavity the entire length of the mass. The cavity is almost closed but here and there occur small apertures which permit the water to circulate on the inside of the mass.

After hatching the baby perch grow rapidly and reach maturity in a year or two. The yellow neds have voracious appetites and feed on small fishes, crustaceans and other matter. Minnows are specially sought after as most desirable food.

Like the trout, the lordly salmon and other favorites, the yellow perch has formed a theme for the poet and the novelist and no less

a person than the eminent Sir Bulwer Lytton has described in "My Novel" an angler's tussle with a perch.

"Young man, listen," said Burley. "When I was about your age, I first came to this stream to fish. Sir, on that fatal day, about 3 P. M., I hooked up a fish—such a big one, it must have weighed a pound and a half, and just when I had got it nearly ashore, the line broke and the Perch twisted himself among those roots and—cacodaeman that he was—ran off, hook and all. Well, that fish haunted me; never before had I seen such a fish. Minnows, I had caught, also gudgeons, and occasionally a dace. But a fish like that—a perch—all his fins up, like the sails of a man-of-war—a monster perch—a whale of a perch! No, never till then had I known what leviathans lie hid within the deeps. I could not sleep till I had returned; and again, sir—I caught that perch. And this time I pulled him fairly out of the water. He escaped, and how did he escape? Sir, he left his eye behind him on the hook. * * * I gazed at that eye, and the eye looked as sly and wicked as if it was laughing in my face. Well, sir, I had heard there is no better bait for a perch than a perch's eye. I adjusted that eye on the hook and dropped in the line gently. In two minutes I saw that perch return. He approached the hook; he recognized his eye—frisked his tail—made a plunge—and, as I live, carried off the eye, and I saw him digesting it by the side of that water lily. The mocking fiend! Seven times since that day in the course of a varied and eventful life have I caught that perch, and seven times has that perch escaped. * * * Good Heavens! If a man knew what it was to fish all one's life in a stream that has only one perch, to catch that perch nine times in all and to see it fall back into the water, plump. Why then, young sir, he would know what human life is to vain ambition."

WHITE PERCH.

The white perch is purely an American fish. It belongs to the same family of fishes as the striped bass, the two possessing many similar traits and habits. It is indigenous to streams on the Atlantic coast from South Carolina to Nova Scotia and some years ago was very abundant in the Susquehanna and Delaware rivers, but owing to the same causes which so crippled the shad fisheries in these rivers, the number of white perch were greatly reduced.

While the white perch seem to prefer to live in brackish waters, they also thrive in fresh water. Whether the transition from strongly brackish water to that which is purely fresh could be made without harm to the fish is a question which has not been settled beyond dispute, but a gradual transition in no wise impairs the health or interferes with the performances of its functions.

To the keen and skillful observations of Mr. Thaddeus Norris, an eminent fish culturist, is due the credit of the almost only reliable information regarding the white perch. Mr. Norris is quoted by Mr. Goode and other eminent writers. He says: "Its most natural habitat is in fresh tidal rivers, where it is found on flat clay and muddy bottoms, and in shallow water. It is frequently found far above the terminus of the tide, and is often more abundant in fresh than in brackish water in the season of the year when sought for by anglers. This fish, when found in salt water creeks, is darker in color, but there is no specific difference. The white perch is a congener of the magnificent rock fish, and is frequently found feeding in the same place and in his company. Its average length is eight or nine inches; it is not often more than twelve, though in rare instances it is found fourteen inches long. White perch hibernate in the deep waters of our bays, and ascend the fresh tidal rivers soon after the ice and snow water have run off. They feed greedily on the spawn of other fish, particularly that of the shad; on insects, crabs, minnows and on the migratory schools of young eels which are found in the months of April and May in great numbers at any rapid or dam obstructing the upward flow of the tide. Perch usually spawn in May, and then resort to deeper waters to recuperate, and all summer long are found by the angler, ever swimming around the deep sunk pier or the timbers of the rickety old bridge, snapping at shrimps or chasing the minnows; at flood-tide high up amongst the water lilies, and never refusing a bait, if of the right sort and properly presented."

Like the yellow perch, the white perch is an excellent pan fish, its flesh being firm and sweet. In comparison with its size its game qualities are strong. It bites vigorously and is a mad rusher and is entitled to a high rank among the game fishes.

WALLEYED AND BLUE PIKE.

Among the fishes which hold high rank both for game and food qualities is the wall-eyed pike, variously called the pike-perch, Susquehanna salmon and jack salmon. It is indigenous in the waters of Lake Erie and was first introduced into the Susquehanna river in the eighteenth century by a Jesuit priest and an Englishman.

It is abundant in the Susquehanna river and its tributaries, the Delaware and Allegheny rivers, and in many smaller streams containing deep holes and rocky bottoms. As a food fish it ranks very high and forms a very important part of the food fish industry of Lake Erie, ranking in fact next to the white fish.

The walleyed pike sometimes attains a weight of thirty pounds. Its flesh is exceedingly white, firm and flaky, without being dry.

Allied to the perch family it has some of its pronounced characteristics, notably the firm tough scales and general shape. But added to the characteristics of the family to which it is bound by ties of relationship, are others which seem to place it among the members of the pike family.

It has a head strikingly like a pickerel. Its jaws and teeth closely resemble those of the "Pirate of the Fresh Water." Its eyes like those of the pickerel are fierce and vengeful, yet there is a lack of brilliancy which has given the fish the title of wall-eyed pike. The color is similar to that of a chain pickerel, and its markings while not absolutely chain-like are yet indicative of the links of a chain.

The disposition of the wall-eyed pike, too, is not unlike that of the pickerel. It is an Ishmael among fishes. It lives almost entirely on live fish and differs from its "double" only in the character of its lurking places. The pickerel hides among lily pads and darts out like a flash upon its unsuspecting prey. The wall-eyed pike lurks among the rocks at the bottom of deep pools, and in the shadows of sunken boulders, and from these ambuscades pounces upon passing fishes. Were it not for its great value for food purposes and for its high rank as a game fish, it would be a dangerous specie to introduce anywhere; but, as it does rank high in both particulars its propagation is both demanded and encouraged.

A wall-eyed pike produces an incredible number of eggs. A female five years old will yield a pint of spawn or 75,000 eggs, and a fish seven years old will yield a quart of spawn or 150,000 eggs. Like all members of the perch family it only requires about ten or twelve days to hatch the eggs. The period of spawning is April and May. The newly hatched fish are almost microscopic in size, but they grow with wonderful rapidity.

In the Susquehanna river the wall-eyed pike is invariably known as the Susquehanna salmon. At the Falls of the Ohio it is called the white salmon, and in the Allegheny river it is termed the jack salmon.

Ichthyologists declare that the wall-eyed pike and the blue pike are identical, with the exception of a few, who admit the possibility of the latter being a variety of the former. Fishermen of Lake Erie, however, laugh the scientists to scorn. They insist that the blue pike is a distinct specie from the wall-eyed pike and point to so many marked variations that for once the fishermen appear to have the better of the argument. There is a difference in the shape of the two fish as well as an appreciable variation in color and marking. The blue pike is a smaller fish and the spawning period is from two to three weeks later than the wall-eyed pike, at least around Presque Isle Bay.

In the territory of Lake Erie under the jurisdiction of Pennsylvania, the blue pike holds the second place in the fisheries industry, ranking next to the lake herring. In 1903, the Lake Erie fishermen caught 1,964,000 blue pike, while the catch of wall-eyed pike was so small as to be placed among the mixed fishes, the total catch of which was only 247,000 pounds.

The fishermen receive three cents a pound for their blue pike or the same sum as is paid for lake herring. The flesh of the blue pike, while not quite as high a grade as that of the wall-eyed pike, is nevertheless rated as high class. It is a fish which belongs essentially to the Great Lakes and all efforts to introduce and establish it in the rivers of Pennsylvania have been failures.

On the Canadian side of the Great Lakes the wall-eyed pike is commonly called a pickerel. There are also one or two other species, one of which called the sauger is of some importance as a food fish. Jordan is one of the few ichthyologists who recognizes the blue pike as a sub-species or variety, and to it is given the name, *Stizostedion vitreum salmonemum*. The wall-eyed-pike lacks the last of these titles.

SHAD.

Far and wide has spread the fame of the shad as a delicious food fish, but of his personal history comparatively little is known, for he spends the greater part of his life in the ocean, beyond the range of human observation. A beautiful fish is he, with his well proportioned, symmetrical body and glistening silver and white livery, the beauty of which is enriched by the contrast with his dark bluish or greenish back.

In the early days the weight of the shad was considerably greater than at present, with the exception of the Delaware and Potomac rivers where artificial propagation has maintained a surplus beyond the increasing demands. During the Colonial period of the history of the United States, shad weighing from ten to fourteen pounds were not uncommon. The female shad is larger and heavier than the male, a pound being the average difference in weight. The female shad averages from three to six pounds, while the weight of the male is from one and one-half to six pounds.

The shad migrate annually to fresh water. These migrations are for a distinct purpose, that of reproduction. While so little is known of the habits of the shad in salt water, it is stated authoritatively that they spawn only in fresh water, returning each year to the spawning grounds at the time when the water conditions are favorable. The greatest run of shad occurs when the temperature

of the water is between 56 degrees and 60 degrees, the numbers growing smaller as the temperature increases.

About the first of April marks the appearance of the shad in the Delaware and Susquehanna rivers. The male or buck shad invariably ascend the rivers first and are followed about two weeks later by the females. It has been said that the males ascend the rivers first to secure desirable nesting places but the fact that shad do not build nests at all, disproves this assertion.

After the return of the shad to fresh water, but little, if any food is consumed by them until after they have spawned. Then they bite at flies or any small shining object, and they have been known to take minnows and artificial flies. When they eat, insects and small crustacea form their principal foods. Fishermen say that food is seldom found in the stomach of adult shad in fresh water, the only substance found looking like black mud.

Until they ripen, the eggs remain in a compact mass in the ovaries. As they ripen this mass becomes loose and the eggs larger. Critical examination of the ovaries discloses the fact that the eggs are not of the same size and quality. The maturing eggs are large and transparent and nearly uniform in size. Smaller eggs of a golden hue, opaque, and varying in size are also found. Whether these smaller, opaque eggs are in process of formation for the next or succeeding years has not yet been determined, nor can it be stated positively that shad spawn every year.

The eggs are discharged by the female while she is in rapid motion, swimming near the surface of the water. She is followed by the male. The impregnated eggs sink to the bottom. The eggs are about one-fourteenth of an inch in diameter, a flattened spherical shape, and a transparent pale amber or pink color. Directly after fertilization, through the absorption of water, they become spherical in shape and much larger in size. They hatch out in a few days.

In the Middle States the tiny fish remain in the pools in which they were born until early autumn. They develop rapidly, attaining a length of three or four inches by September. Small insects and animalculae are their food. At this stage they journey to the sea in large schools, dancing and leaping from the water as they go and appearing to the spectator like a shower of glistening silver. After reaching the sea all knowledge of them ceases until three years later when they return, mature fish, ready to contribute their share to the wonderful story of reproduction.

Not all of the eggs extruded by the female are hatched. Many fail to be fertilized and numerous enemies prey upon those hatched. Other fishes like the bass, the eel and the perch consider the little creatures choice morsels and devour large numbers of them. Nor

do their troubles in this direction end when salt water is reached. Many of them elude their fresh water enemies only to become the prey of sharks, horse-mackerel, kingfish, etc. The development of fungus is another source of danger to the shad eggs and the deposits of mud caused by heavy rains also suffocate large numbers of them. Indeed were it not for artificial propagation the extermination of the shad would be an accomplished fact.

About 30,000 is the average number of eggs deposited by the shad, although there are cases on record where the yield of a single fish reached 60,000, 80,000, 100,000 and even 115,000 eggs. One hundred and fifty-six thousand eggs are accredited to one fish taken from the Delaware river in 1885.

The vitality of the female shad is greatly reduced by the labor of spawning and the small amount, if any, food consumed during this period. There is no question that large numbers die from weakness. Immediately after spawning both the male and female shad exhibit a strong instinct to reach the sea and it is sometimes pitiful to observe the struggles made by a sick or dying fish to reach his natural dwelling place. In this condition they become more readily the prey of other enemies. While in fresh water in normal condition, adult shad are usually unmolested.

Along the entire eastern coast of the United States to the Gulf of St. Lawrence shad may be found, nor are they confined to the eastern coast. The Fish Commission of California, some years ago, introduced them into the Sacramento river and in consequence they have spread from Southern California to Southeast Alaska. For superiority in quality and abundance, the eastern coast is by far the greatest shad territory. In this location they are indigenous.

Not only is the shad most popular as a desirable and delicious food fish, but its commercial value is of the highest rank. In every Atlantic State from New Jersey to Florida, inclusive, the shad occupies first place. In New York, the blue fish only exceeds it in value while of all the economic fishes of the United States it ranks next to the salmon and cod, commercially.

The shad did not always hold this high rank as a food fish everywhere in America, as will be noted in the story of the Hadley, Mass. family, which is recorded elsewhere in this pamphlet.

The shad illustrates very forcibly the superior value of artificial propagation over the natural hatching of the eggs. It has been estimated that by natural spawning not more than one per cent. of the eggs are hatched and the young thereof reach the sea in safety, while by artificial propagation over ninety per cent. have been incubated.

Apropos of the shad there is a story said to be of Indian origin which accounts for the existence of the shad and its bony character.

According to the story, in the early days of animal life the porcupine proved to be a disturbing element. Nothing which the Good Spirit did was right. From morning until night the porcupine found fault with everything. Nothing on land was beautiful or pleasing. At length the Good Spirit lost his temper. He seized the porcupine by the scruff of the neck and cast it in a nearby river saying, "Try how you like life as a fish," and a shad he became. In tossing the animal, the Good Spirit did it so violently that the porcupine was turned inside out, hence the bony character of the shad.

Note.—It is impossible to exhibit live shad in aquariums because it is of such a tender character that a slight bruise or the loss of a scale or two, means its death within an hour.

THE HERRING OR ALE-WIFE.

First cousins to the delicious shad, the herring closely resemble them in general appearance and coloring, although much smaller in size. Less than two hundred years ago, it is said that Englishmen claimed the herring were created especially for their benefit and in support of this theory one writer, about 1750, advances the following ingenious explanation:

"There have been many conjectures from whence (the herring) they came to England, and most have concluded that it is unknown but it must be somewhere very far north; and we may reasonably suppose that some providential impulse causes them yearly, and at such a period to send off a detachment to us for human use." Then follows a description of the annual route of the herring, according to his belief. He claims, "they start from Greenland and go straight to Shetland, from thence to the northern part of Scotland, there the great school of herring divides into two parts, one going down the east and the other the west coast of the British Isles. The remains of these two schools then unite and cross the Atlantic to North America, where they swim southward along the British possessions to the Carolinas. Here they turn and swim back to Greenland." The writer further states that many herring reach the Dutch shores but few, if any go near France, Portugal or Spain which makes it appear that the herring "were forbidden to go that way on purpose that we might supply them."

All along the entire eastern coast of the United States, the herring or alewives are found. They are of great commercial value and in every Atlantic State from Maine to Florida, an alewife fishery is located. The herring is used extensively as a food both fresh and salted or smoked. The herring industry is ranked among the most valuable of the fishing industries of the United States.

Like the shad, the alewives migrate from the ocean to fresh water every year to spawn. They usually arrive in fresh water two or

three weeks before the shad. They are exceedingly prolific, ranking ahead of both the shad and sea herring in this particular. One hundred thousand eggs is regarded as the average number spawned by a single fish. The eggs are quickly hatched, six days usually being the time required for this purpose. The baby herring are very tiny but they develop rapidly and by the time they are ready to migrate to the ocean in the autumn, they are two or three inches in length.

In the early seventies, experiments were made in the artificial propagation of the herring. No difficulty was encountered and the process is much the same as that employed in the artificial incubation of shad. As yet, however, there is no need to propagate alewives artificially, for in spite of the great catches, the supply seems undiminished. This is due, no doubt to the great prolificness of the fish and the protection it is afforded by fishways in the New England States.

WHITE FISH.

In scientific circles the white fishes belong to a race whose family name is *Coregonidæ* and whose generic title is *Coregonus*. Four species of this genus have their abode in Pennsylvania waters as well as in all the Great Lakes and northward into British America. A very important specie, whose history has been related, is the *Coregonus artedi* or lake herring. Another branch is the *Coregonus quadrelateralis* commonly known as the round white fish and more important in the Adirondack region of New York and the lakes of New England than in the Great Lakes. A third variety is the *Coregonus tullibee*, usually known as the tullibee but sometimes styled the "mongrel white fish" on the supposition that it is a hybrid.

From a commercial and food standpoint the most important specie of the four is the *Coregonus clupeiformis*, our common white fish of the lakes. All four species, however, are well esteemed for their food qualities.

Dr. Jordan classes the white fishes as by far the most important group of freshwater fishes of North America, and probably of the world. Among the fishes of all the Great Lakes, the common whitefish ranks next to the lake herring, lake trout and wall-eyed pike, in value of the catch. In the fisheries of Lake Erie within the jurisdiction of Pennsylvania, the whitefish occupied third place in 1903, the lake herring heading the list and the blue pike having second place.

Many phases of the life of the whitefish are enveloped in mystery, because of its habit of spending a portion of its life in deep waters, where it cannot be observed. It is known that the whitefish usually make two pilgrimages a year to shoal water. The first occurs in the

spring during the latter half of April and in May. No specific cause for this migration has been determined. It is during this period that the pound net catches are made. Gill-nets are also set about the first of April for the opening catch of the season.

About midsummer the white fish retire into the deep waters, there to remain until the approach of the spawning season again sends them shoreward. From the latter part of October until December is the spawning time of the white fish. Immediately after spawning, the white fish retire to the deep waters of the lake, there to remain during the winter.

Spawning operations usually are most active in the evening and during the night. Several hundred eggs are deposited at one time, the fish spawning about 10,000 eggs for each pound of her weight. The eggs are about one-eighth of an inch in diameter, 36,000 of them equalling a fluid quart. The period of incubation varies with the temperature. The baby fish are very active and speedily seek deep waters as a means of safety. When very young they are not usually found in schools, but swim near the surface of the water in smaller numbers. They feed on crustaceans and animalculæ chiefly.

Naturally spawned eggs are subjected to the attacks of many enemies. So many other creatures consider them desirable food that immense numbers of them are consumed and but a very small percentage ever reach maturity. The water lizard, lake herring, yellow perch, craw fish, wild fowls, all consider the eggs their especial food, nor are they allowed freedom even after they have been successfully hatched, for the pike perch, pickerel, black bass and others consume the little white fish with great relish.

A rapid grower, the white fish of four months is frequently five inches long. The only way to secure data in regard to their growth and some other habits, is to closely observe white fish artificially reared. The common white fish attains a larger growth than the other members of its family. While the average weight is under four pounds, fish weighing over twenty have been taken.

The value of artificial propagation is forcibly illustrated in the white fish industry. Indeed, the industry on an extensive or even moderate scale would not be possible were it not for this process. But a very small percentage of eggs naturally spawned are ever hatched, while from 75 to 95 per cent. taken artificially are successfully hatched and distributed. Pennsylvania alone plants annually in Lake Erie about 45,000,000 white fish fry.

No one save the commercial fishermen need hope to catch the white fish. He is purely a food fish and has no game qualities to excite the admiration of the disciples of Izaak Walton. A hook and line are not for him, and no available baits have ever succeeded in luring him from his haunts. Gill and pound nets are the instru-

ments for his capture and the angler as well as the world in general may possess him through the medium, not of a hook and line, but the markets.

Large quantities of white fish are shipped to the markets of Pittsburg, Erie, Buffalo, Cleveland, Sandusky, Detroit, Chicago, and other centers, during the season. Great quantities are also packed in ice and frozen and shipped to the various markets oftentimes fifteen or eighteen months later, so that the popular demand for "fresh" fish may be supplied.

CISCO OR LAKE HERRING.

From Bulletin No. 1, issued by the Department of Fisheries of Pennsylvania, it is learned that 5,033,000 pounds of lake herring was the output for the year 1903, of Lake Erie within the jurisdiction of the Commonwealth of Pennsylvania. When it is considered that Pennsylvania is only one of several states controlling fish industries on this lake, and that Lake Erie is, itself but one of a chain of great lakes, some idea of the magnitude of the fishery industries of the Great Lakes may be acquired.

The lake herring or cisco occupies first place in the commercial importance of the lake fisheries. Indigenous to all the Great Lakes, the specie is most abundant in Lake Erie, Lake Michigan holding second place.

Cisco or lake herring belongs to the family of white fish. It is known by various names in the different localities in which it is found. Cisco is the name used in Lake Ontario. This name is supposed to have originated through a fish peddler of that name, who, in selling the fish to the farmers of New York State, called them Cisco's herring. Other designations used in Lake Ontario are herring, blue back, blueback herring, green back or greenback herring, gray back or grayback herring. In Michigan, the names Michigan blueback and shore herring are frequently used. In the other lakes as well as in Canada, herring or lake herring is the popular name for this fish.

While the aggregate number of pounds of lake herring caught annually far exceeds that of all the other white fishes combined, commercially it is not as valuable nor is it ranked as high class a food as the white fish.

Smaller in size than the white fish, with a projecting lower jaw, it is easy to distinguish the two fishes. The herring has a bluish black or greenish back and silvery sides with pale streaks along the rows of scales. Its average length is about twelve inches with a weight not exceeding a pound although longer and heavier specimens have been caught.

During the summer and winter the lake herring lives in the deep waters of Lake Erie from which region it makes two great migrations each year into the shoal waters of the lake. When the shoal water becomes warmer in the spring, the fish evidently in search of food, travel in great schools towards the shore. At the beginning of summer, they return to the deeper waters. In the fall, the herring again travel towards the shoal water but this time it is for the purpose of spawning.

From Erie, the chief fishing centre of this locality, the best season for lake herring is from July to September. The spawning season occurs in November. It requires from four to five months to incubate the eggs. They are very small, about 70,000 being required to fill a quart measure. Insects and crustaceans are the principal food of the lake herring, although during the spawning season of the white fish, it devours all the spawn of that fish it can secure.

An interesting fact from a scientific standpoint in regard to the lake herring and the white fish, is the ease with which hybrids can be propagated artificially. The milt of either fish will fertilize the spawn of the other as effectively as if it were the same species. Lake Erie has yielded fine specimens of this hybrid, although this cross fertilization is not practical except occasionally in case where the eggs would otherwise be lost.

CHAIN PICKEREL.

Chain pickerel may be found in most of the streams east of the Alleghenies from Maine to Florida, Louisiana, Arkansas and Tennessee. It is a very familiar member of the finny tribe in the ponds and lakes of most of the New England and Middle States. It is known by other names; for instance, "Jack," in the south; also green pike in the lake region; common eastern pickerel in most other localities. In early federal days it was also known in parts of New York as "federation pike," because the markings on its sides were thought to resemble the symbol of the Federal Union stamped on some of the coins in circulation a century ago.

Pickerel are early spawners. As soon as the ice and snow-water are gone, they may be found among the weeds or in bushes or branches of trees which project in the shoal waters. Here they remain until the spawn is deposited in the latter part of winter or early spring. Their parental instincts are not strong for they leave the spawn to care for itself, while they go elsewhere in pursuit of prey. Aided by the warmth of the sun, the little fish are hatched in time. There is no mistaking the family to which they belong for before they are the length of the little finger, they are diligently searching for choice morsels to eat. The baby silver chub and

shiners are victims of their voraciousness. The mature pickerel consume vast numbers of minnows and other luckless creatures, like frogs and snakes, that venture in the their vicinity.

Chain pickerel are the largest of the several species of this group. Sometimes they grow to be two feet long and seven or eight pounds in weight, but they do not generally average these dimensions. Yellow-green or brown is the color of the pickerel and its sides are covered with an interlacing network of dark lines. This network of lines suggested the common term, chain pickerel, and the scientific name, *reticulatus*, the generic name being *Esox*.

As a food fish, the pickerel occupies an average place. The flesh is generally firm and flaky, but usually dry and with many small bones. The flavor is pleasant and many people eat it with a relish. As a game fish it furnishes good sport and in some localities is considered quite important. It is an especial favorite with young anglers and also those of the fairer sex who indulge in piscatorial sports.

MUSKALLUNGE.

Of the variety of ways of spelling the name of this fish, muskallunge is the form now usually adopted. The spellings are as numerous as the derivations recorded, although obscurity has thrown such a veil around the latter, that no positive assurance is given as to which is the correct one. Some authorities claim that the word muskallunge is derived from the Ojibwa or the Cree Indians; others, that it is a Chippewa derivative; and still those who claim for it a French descent. There are arguments in favor of all. In regard to the spelling, each one may choose for himself from the following array: Muskallunge, muscalonge, muscallonge, muscallunge, muskellunge, musquellunge, masquinongy, maskinongy, maskinonje, and others.

A fish with such a goodly array of titles should be important. The muskallunge is regarded as a magnificent fish and the noblest of the pike family. This fish is found in all the Great Lakes and some of their tributaries, in parts of the Upper Mississippi Valley, in the St. Lawrence river and in Canada. New York and Pennsylvania have also propagated muskallunge artificially and planted the fry respectively, in the lakes of New York State and the Susquehanna river.

Muskallunge have been caught that weighed 80 and 100 pounds, and that were eight feet long. Twenty-five or thirty pounds in weight and about three feet in length represent the average fish. The muskallunge is without question one of the largest fresh water fishes in the United States.

They are prolific fish, from 100,000 to 300,000 eggs being the aver-

age number deposited by a single fish. The spawning season is spring, although later than the pickerel. It is said that the young pickerel devour great quantities of these eggs, as do also frogs, turtles, ducks and coots. Should all these eggs be hatched, it might be a misfortune, for the muskallunge is extremely voracious and consumes great quantities of live fishes.

The muskallunge has a large mouth which is furnished with many long, sharp, conical teeth, of various sizes. These great jaws and terrible teeth are instruments of certain death to any creature that comes within range of them. The color is usually dark gray with numerous black spots, roundish in form. The lower side of the fish is pale in color. The spots become more or less obscure with age.

As a food fish it is valuable when compared with the rest of the family in this respect, although it is sometimes much overrated. As a food it does not compare favorably with the black bass, trout, and white fish. It is always salable in the markets, however. The muskallunge is a good fighter and quite capable of trying the skill of the angler to the utmost and is therefore considered a fine game fish although the pleasure in landing him is doubtless due more to his great size than his gameness.

THE GAR FISH.

This fish has quite an extensive habitat as it ranges from the Great Lakes, through the Mississippi Valley, south to Mexico, and from Pennsylvania to South Carolina on the east, to the plains on the west. According to Professor Cope two varieties are found in Pennsylvania. One variety is described as being robust in form, with a short face and gill covers, and roughened scales on the front part of the body. The Susquehanna and lower Delaware are its abiding places. The other variety is smaller in size, with a more slender face and gill covers, smoother scales and no dark spots on its body and fins. It is to be found in lakes and the Allegheny river.

Like the Muskallunge this fish is also provided with numerous names, being expected to respond to any of the following: Bill-fish, sword-fish, bony gar, bony pike, buffalo-fish, alligator and allegator gar.

The gar is also a predaceous fish. It grows to a length of five or six feet, the head and snout occupying about a third of the whole length. Late spring and early summer are the spawning times and shoal water or the streams, the places selected for spawning purposes.

This species is not considered a food fish as the flesh is tough and considered unwholesome. Gar fish are found in greater numbers in the Great Lakes and large rivers than in the smaller streams.

EELS.

Until a few years ago the eel was among the most mysterious of all our fishes. No one had ever seen any spawn. No one knew whether it was a distinctively fresh, or salt water fish, or both, or was there much known about the eel except that it was found in both the rivers and the ocean.

There were people who believed that the eel had its origin in the hairs from the tails of horses. The ancient Greeks, skilled in the history of the reproduction of other fishes, could discover nothing about the eel. It was the custom in those days to consider Jupiter the progenitor of all children whose paternity was doubtful so as nothing was known of the eel, it too was attributed to Jupiter. Aristotle advanced the theory that they were generated spontaneously. Various other legends, equally absurd, occurred from time to time. For years scientific men sought to discover the habits of this fish but it was not until 1877 that they achieved success. In that year Jacoby carefully investigated a number of problems which have also been studied by other investigators since then. As a result the essential facts in the life history of the eel are now well known. Dr. Jordan briefly states them as follows:

"The common eel spawns in salt water, usually off the mouth of rivers, or mudbanks, to which they go in great numbers at the spawning time, which is in the fall. On these mudbanks the eggs are laid, fertilization takes place, and the young eels develop within two or three months after hatching. At the beginning of the second spring these young find their way to mouths of the rivers, which they ascend in incredible numbers. In these fresh water streams and lakes they remain until of adult size, when they return to the sea for spawning purposes. This seaward migration takes place in the fall, at which time large numbers are caught in traps. During this migration, the eels, like the salmon and the shad, do not take any food. Having once reached the sea, they do not remain close to shore, but go out a distance to deeper water, where the development of the reproductive organs takes place very rapidly. This development is extraordinarily rapid when the immature state, in which the migrating eels found, are considered; they probably become sexually mature within five or six weeks after reaching the sea. The spawning then takes place, after which both the old males and females die, never returning to fresh water the second time. The very unusual rapid development of their reproductive organs has such an effect upon the systems of the adult eels that they die soon after the act of reproduction. This is the reason that adult eels are never seen migrating up-stream.

"The down-stream movement occurs usually at night, commencing soon after sunset, is strongest from midnight to 2 o'clock A. M., and ceases an hour or more before sunrise."

Eels have been known to grow very large, sometimes exceeding a length of four feet and a weight of sixteen pounds, although the average length is about two feet. The female is the larger of the two sexes, is paler in color, and very prolific. An eel 32 inches long has produced 10,700,000 eggs.

Spawn is a favorite food of the eel although they feed upon all sorts of refuse, preferably dead fish or other animal substances. Live fishes are caught also by the eel and eaten without ceremony. They are supposed to be able to live out of water for some time and have been known to travel over wet grass or moist rocks to avoid obstructions in streams or seek a newly-made pond which instinct seems to teach them exists nearby.

The common eel is found in Eastern North America from Newfoundland to the Gulf of Mexico and Central America. In Pennsylvania it is considered a good food fish and is always marketable.

THE CATFISH.

Catfish do not belong to the aristocratic fishes although they have contributed frequently to the entertainment of aristocratic people, that is, to their appetites. The catfish and waffle suppers served at the roadside inns on the banks of the Schuylkill in the vicinity of Philadelphia, twenty-five or thirty years ago, were famous in their time and attracted visitors from long distances.

Any sort of water will do for a home for the catfish. It matters not to them whether it be clear or muddy, a stream or a ditch, or whether or not the health authorities pronounce it a menace to the public health. It is this seeming indifference to their place of abode and indelicacy of appetite which cause some unjust and hard criticisms to be made against them.

In fact, the catfish is not only a good but a favorite fish food, of many people. When properly cooked, it is even delicious. The meat is white, of a good quality, and excellent flavor. The catfish of the Schuylkill river were of so superior a quality as to make them famous. The United States Bureau of Fisheries regarded them so highly as to introduce them to the waters of the Pacific slope.

Scattered over the world are more than a thousand species of catfish but only thirty of these are indigenous to the United States. The others are found principally in Mexico, Central America, South America and Africa. Some are fresh and some salt water varieties. With the exception of four species all the others are found in the Atlantic, Mississippi Valley and Gulf States.

The catfish are prolific breeders. June or early July is the spawning time. *Like* many others, the catfish are nest builders and *unlike* many of their finny relations, they do not devour their offspring, but take as good care of them as a hen does of her young brood.

When spawning time approaches, the male and female go house hunting, that is they seek for a suitable place to locate a nest. A cave or hole is dug and in it are deposited the eggs which are kept close by the parents in turn. The eggs require about five days to hatch them. After they are hatched, the wee fish are cared for most tenderly by the father, the mother occasionally relieving him of the care. In about three weeks the young fish are able to care for themselves, at which time they are deserted by the old ones.

The white, the yellow, the blue, the channel, the spotted, the stone, and the bullhead are among the best known varieties of the catfish.

While not indigenous to Europe, the catfish has been introduced into some parts of it and with success, for the catfish is not difficult to transplant. Judging from some verses contributed by Punch, the attempts to introduce the catfish into England were not successful or rather not desired.

No Catfish, Please!

"Oh do not bring the catfish here!

The catfish is a name of fear.

Oh, spare each stream and spring.

The Kennet Swift, the Wandle clear,

The lake, the loch, the broad, the mere,

From that detested thing!

The catfish is a hideous beast,

A bottom-feeder that doth feast

Upon unholy bait:

He's no addition to your meal.

He's rather richer than the eel;

And ranker than the skate.

His face is broad, and flat, and glum;

He's like some monstrous miller's thumb;

He's bearded like the pard.

Beholding him the grayling flee,

The trout take refuge in the sea,

The gudgeons go on guard!

He grows into a startling size;

The British matron 'twould surprise.

And raise her burning blush,

To see white catfish, large as man,

Through what the bards call 'water wan'
 Come with an ugly rush!
 They say the catfish climbs the trees,
 And robs the roost, and, down the breeze,
 Prolong his catterwaul.
 Ah, leave him in his western flood,
 Where Mississippi churns the mud;
 Don't bring him here at all!"

—From Punch.

WHITE AND YELLOW CATFISH.

Very abundant in the Potomac and Susquehanna rivers, the white catfish is frequently called the Potomac cat and is an important factor of the fish supply of the markets in the region of the Chesapeake. The white catfish is also abundant in the coast streams from the Delaware river to Texas. Its head is very wide and its mouth very large. In color it is pale olivaceous or blush, silvery below, sometimes clouded or mottled but without dark spots. It weighs from two to five pounds and reaches a length of two feet and less. This species has been introduced into California and is growing numerous there.

Most abundant in sluggish waters the yellow catfish is found southward from the Great Lakes to Virginia and Texas. It is yellowish in color, clouded with a darker tint. Its length varies from twelve to eighteen inches and from one to two pounds is the average weight. The yellow or chubby cat as it is sometimes styled is one of the best known fishes of its district. This is one of the most variable species of catfish, several varieties being accredited it. Of these, three are found in Pennsylvania.

CHANNEL AND SPOTTED CATFISH.

As the name indicates, this genus of the numerous catfish family prefers the channels of rivers for their abiding places. There are four known species of this genus, three of which are good food fishes. The Great Lake region, the Mississippi Valley and the Gulf States are the original habitat of this genus, known to ichthyologists as the *Ictalurus Rafinesque*.

One of the species is the spotted cat. This specie has at times been confused with the blue cat, and is a consequence, some data regarding its exact size and habitat have not been definitely settled. In Pennsylvania, it is found only in the Ohio and its tributaries, but it is being introduced into other than native waters. The spotted cat prefers the running waters of clear, pure streams, while its relative, the blue cat, adapts itself to sluggish waters. Because of

its more cleanly habits, its flesh is firmer, flakier and possibly better flavored than the other species of this family.

The color of the spotted cat varies. The mature fish are a bluish silvery color while the young are spotted with olive. This variation in color and number of fin rays has caused this species to be described under a variety of names. The spawning time varies from April to June according to locality.

BULLHEADS.

One of the most abundant and best known members of the cat-fish family is the bullhead of the Northern and Eastern States. It is called by several names, the best known being "horned pout," "bull-pout," "bull-head," and "minister." The bullhead in Pennsylvania is also known as the Schuylkill cat and it was this variety that was introduced into the Sacramento and San Joaquin rivers of California and some small lakes and streams in Southern Oregon.

The bullhead is a very hardy specie and thrives in many waters, preferring those which are quiet and shaded. It is the small cat-fish found in so many small lakes, ponds and streams. The bullhead sometimes attains a length of twelve or fifteen inches and a weight of one or two pounds. Occasionally larger ones are found, but usually those on sale in the markets are much smaller in size.

George W. Peck has written a burlesque describing the habits of the bullhead, which is such an accurate, as well as very witty story of this fish, that it is well worth reproducing for the readers of this pamphlet:

"It seems that the action of the Milwaukee Common Council in withdrawing the use of the water works from the fish commissioners will put a stop to the hatching of white fish. This is as it should be. The white fish is an aristocratic fish that will not bite a hook, and the propagation of this species is wholly in the interests of the wealthy owners of fishing tubs, who have nets. By strict attention to business they can catch all of the white fish out of the lake a little faster than the State machine can put them in. Poor people cannot get a smell of white fish. The same may be said of brook trout. While they bite a hook, it requires more machinery to catch them than ordinary people can possess without mortgaging a house. A man has got to have a morocco book of expensive flies, a fifteen dollar bamboo jointed rod, a three-dollar trout basket, with a hole mortised in the top, a corduroy suit made in the latest style, top boots of the Wellington pattern, with red tassels in the straps, and a flask of Otard brandy in a side pocket. Unless a man is got up in that style a speckled trout will see him in Chicago first, and then it won't bite. The brook trout is even more aristocratic than the white fish, and should not be propagated at public expense.

"But there are fish that should be propagated in the interest of the people. There is a species of fish that never looks at the clothes of the man who throws in the bait, a fish that takes whatever is thrown to it, and when once hold of the hook never tries to shake a friend, but submits to the inevitable, crosses its legs and says, 'Now I lay me,' and comes out on the bank and seems to enjoy being taken. It is a fish that is a friend of the poor, and one that will sacrifice itself in the interest of humanity. That is the fish that the State should adopt as its trade-mark, and cultivate friendly relations with, and stand by. We allude to the bullhead.

"The bullhead never went back on a friend. To catch the bullhead it is not necessary to tempt his appetite with porter-house steak, or to display an expensive lot of fishing tackle. A pin hook, a piece of liver, and a cistern pole is all the capital required to catch a bullhead. He lies upon the bottom of a stream or pond in the mud, thinking. There is no fish that does more thinking, or has a better head for grasping great questions, or chunks of liver, than the bullhead. His brain is large, his heart beats for humanity, and if he can't get liver, a piece of tin tomato can will make a meal for him. It is an interesting study to watch a boy catch a bullhead. The boy knows where the bullhead congregates, and when he throws in his hook it is dollars to buttons that 'in the near future' he will get a bite.

"The bullhead is democratic in all its instincts. If the boy's shirt is sleeveless, his hat crownless, and his pantaloons a bottomless pit, the bullhead will bite just as well as though the boy is dressed in purple and fine linen, with knee-breeches and plaid stockings. The bullhead seems to be dozing on the muddy bottom, and a stranger would say that he would not bite. But wait. There is a movement of his continuation, and his cow-catcher moves gently toward the piece of liver. He does not wait to smell of it, and canvass in his mind whether the liver is fresh. It makes no difference to him. He argues that there is a family out of meat. 'My country calls and I must go,' says the bullhead to himself, and he opens his mouth and the liver disappears.

"It is not certain that the boy will think of his bait for half an hour, but the bullhead is in no hurry. He is in the mud and proceeds to digest the liver. He realizes that his days will not be long in the land, or water more properly speaking, and he argues that if he swallows the bait and digests it before the boy pulls him out, he will be just so much ahead. Finally, the boy thinks of his bait, pulls it out, and the bullhead is landed on the bank, and the boy cuts him open to get the hook out. Some fish only take the bait gingerly, and are only caught around the selvage of the mouth, and they are comparatively easy to dislodge. Not so with the bull-

head. He says if liver is a good thing, you can't have too much of it, and it tastes good all the way down. The boy gets down on his knees to dissect the bullhead, and get his hook, and it may be that the boy swears. It would not be astonishing, though he must feel, when he gets his hook out of the hidden recesses of the bullhead, like the minister who took up a collection and didn't get a cent, though he expressed thanks at getting his hat back. There is one drawback to the bullhead, and that is his horns. We doubt if a boy ever descended into the patent insides of a bullhead to mine for limerick hooks, that did not, before his work was done, run a horn into his vital parts. But the boy seems to expect it, and the bullhead enjoys it. We have seen a bullhead lie on the bank and become dry, and to all appearances dead to all that was going on, and when a boy sat down on him and got a horn in his elbow and yelled murder, the bullhead would grin from ear to ear, and wag his tail as though applauding for an encore.

"The bullhead never complains. We have seen a boy take a dull knife and proceed to follow a fish line down a bullhead from head to the end of his subsequent anatomy, and all the time there would be an expression of sweet peace on the countenance of the bullhead, as though he enjoyed it. If we were preparing a picture representing 'Resignation,' for a chromo to give to subscribers, and wished to represent a scene of suffering in which the sufferer was light-hearted, seeming to recognize that all was for the best, we should take for the subject a bullhead, with a boy searching with a knife for a long-lost fish hook.

"The bullhead is a fish that has no scales, but in lieu thereof has a fine India rubber skin, that is as far ahead of fiddle-string material for strength and durability as possible. The meat of the bullhead is not as choice as that of the mackerel, but it fills up a stomach just as well, and *The Sun* insists that the Fish Commissioners shall drop the hatching of aristocratic fish and give the bullhead a chance."

SPOON-BILL CAT OR PADDLE-FISH.

It has only been within the last few years that the spoon-bill cat has been regarded as possessing a commercial value. Except the negroes in the south, no one else deemed it valuable as a food. The negroes ranked it with the channel cat and the goujon. Now it is a market product commanding a fair price. The flesh of the spoon-bill is somewhat like that of sturgeon. Indeed, in some places it is smoked and sold under that name. The roe of the spoon-bill cat is more valuable than its flesh for it is made into caviar and commands a high price. The caviar industry is a profitable one and a

number of centres have been established in Mississippi and Tennessee, along the Mississippi river, besides several in other localities.

Information concerning the habits of this fish and their young is not extensive. Very little is known regarding the spawning season. From the little knowledge at hand, it is supposed that in the lower Mississippi Valley it occurs in March and April, while farther north May and June are probably the spawning months. All knowledge of the young is veiled in mystery. There is no record of any one ever seeing a spoon-bill cat less than six or eight inches long, although there are numerous accounts of the great size attained by the adult fish. Spoon-bills over six feet long and four feet in circumference and weighing 150 pounds have been caught.

Like many others of the finny tribe this fish has numerous names; spoon-bill cat, paddle-fish, shovel-fish, bill-fish, spoon-billed sturgeon, being some of them. The spatula-like snout is probably responsible for most of these names.

Although the spoon-bill cat seems to enjoy the muddy bottoms of streams, it does not eat the mud and slime as has been supposed. Water worms, beetles, insects, leeches and aquatic plants satisfy its appetite. Its long and peculiar snout is very useful in securing food.

There is but one species of paddle-fish found in America, and it is chiefly confined to the Mississippi Valley, although it is found in some of the larger waters of Pennsylvania, principally the Allegheny and Monongahela rivers. In China and Japan a similar fish is found but it belongs to a different species. It might be considered curious that one species existed in Japan and one in the United States, but there is a possible solution of the mystery in the fact that at one time in the world's history there was a land connection between American and Japan. This may not be the reason for the two fishes existing as they do, but it is at least a co-incidence.

STURGEON.

With an ancestry dating back millions of years to the Devonian or Age of Fishes and flourishing in all successive ages, the sturgeon may well be considered a very aristocratic fish. In his "Creatures of Other Days," the Rev. H. P. Hutchinson says of the sturgeon, "Concerning its long pedigree, we ought to look upon this fish with great veneration. There are indeed, few fishes which can boast of such an ancestry, although unlike the gar-pike, it has not retained its primitive form. Its armor, one of the characteristics of the Ganoid fishes, having almost entirely disappeared, there being but a few plates down the back. Its cusp like teeth are also gone."

Many of the early American colonists were greatly impressed with the huge size and vast numbers of the sturgeon. The letters of William Penn, Peter Kalm, the botanist, and of others, all contain references to the sturgeon. Yet in spite of its ancient pedigree and its apparent might, it was considered comparatively worthless. This ignorance or lack of appreciation of its merits has very nearly completed its extermination. The sturgeon was slain ruthlessly, and tossed aside as worthless. It is only within the last few years that commercial fishermen, and people in general, have awakened to the fact that every part of the sturgeon is valuable and desire to atone for their past destructiveness by securing the artificial propagation of this great fish.

There are six species of sturgeon indigenous to the United States. Of these the common sturgeon of the Eastern United States is the best known. This species was found in the Delaware river in great abundance and supported large industries on the banks of that river. Now the sturgeon has become so rare that the large majority of them have been practically abandoned and unless the waters are stocked with sturgeon artifically propagated, the day is not far distant when this wonderful survivor of a wonderful age will no longer exist.

Common sturgeon attain a length of twelve feet and a weight of 500 pounds. Recently this size is diminishing and from 60 to 150 pounds represents the average weight. Spring and summer are the spawning months and it is at this period that the sturgeon ascend the large rivers from the ocean. A single sturgeon will deposit from 1,000,000 to 2,500,000 eggs. The eggs are quite small, being about one-ninth of an inch in diameter, and are of a glutinous character. About seven days are required to hatch them.

The mouth of a sturgeon is a curious structure. It has no teeth, but instead possess an organ, cup shaped, made of muscular tissue and very powerful, with which it draws food, by means of suction, from the mud. The food of the sturgeon consists of small shell fish, crustaceans, insect larvae and similar foods. A number of sensitive tentacles around the mouth assist the sturgeon in its search for food. Huge as the sturgeon is, it possesses the power of leaping. In doing so, the entire body of the fish appears out of the water and falls back with a great splash.

Not a particle of the sturgeon is wasted but a definite use has been found for each part. The roe or ova is by far the most valuable part. From it is manufactured a great delicacy known as caviare. In manufacturing caviare the eggs are separated and treated with Lunenburg salt. After this treatment the mixture is termed caviare and is packed in kegs which are for the most part shipped to Europe. There the caviare is repacked in cans or jars, labelled with a Russian

label and returned to this country as a Russian product. The story of this industry has been told in a previous chapter.

The flesh of the sturgeon is thoroughly cleaned, packed in ice and shipped principally to the markets of New York and Philadelphia where it is sold to dealers. Some of the flesh is sold fresh, but most of it is smoked and commands a good price. From the skin, fishermen make a twine or rope that is a very strong. Portions of the head, hide and back-bone are boiled and a fine oil obtained therefrom, which is used in the tanneries. The refuse is converted into an excellent fertilizer.

Italians on the Pacific coast make a food resembling tripe out of the principal intestine. The Chinese, who are credited with being very fine cooks, make soup out of the gills and marrow from the back-bone. The bones and scales of the sturgeon were used by the Indians for rasps and graters.

The sturgeon was also found in abundance in some parts of Europe. The Danube, the Don and the Volga were famous sturgeon rivers. A few years ago, when this fish was more plentiful, it formed the principal food of European Russia during the fast days of the Greek church. When it learned that these fast days average one-third of the entire year, some conception can be obtained of the vast quantities of fish consumed for the population of Russia is represented by no small number.

Sturgeon was once considered a royal dish. A story is told of how the sturgeon was served at dinner during the reign of the Emperor Severus. After it was prepared it was borne to the banquet hall by servants wearing coronets and escorted by musicians, who discoursed sweet music. No State dinner was complete without this course. It is also stated that a soup made from sturgeon and expensive wines cost 3,000 roubles.

Systematic work in the artificial propagation of the sturgeon has not yet been undertaken although a number of experiments have been made and with such results as to demonstrate that this work is not impossible. Plans are being perfected by which the Commonwealth of Pennsylvania in conjunction with New Jersey and possibly Delaware, can undertake the work of stocking the Delaware river with artificially reared sturgeon and rehabilitating the fisheries on that river.

BURBOT.

The burbot is a very voracious fish and strongly exorcated by the fishermen of the Great Lakes, who loudly demand its extermination. Nevertheless there are fishermen who do not hesitate to make use of the burbot or eel-pout, as it is sometimes called, when they desire to hoodwink the unsuspecting consumer of catfish. These con-

scienceless men will skin the burbot, cut off a short distance back of the head, and sell the rest of the body for the lake catfish.

This fish is the only member of the cod family in America that reside permanently in fresh water. It is found in the Great Lakes as well as the larger lakes of Canada and the northern United States from Maine to Alaska. It has incurred the enmity of the Great Lake fishermen because it feeds so extensively on the choice fishes of the lakes.

In the Great Lake region the burbot averages about two feet in length, while in Alaska, specimens five feet long and weighing 60 pounds, have been found occasionally. The food supply greatly influences the size of the fish.

Except in the spawning season in March, when it selects hard or rocky beds, mud bottoms in deep water are the usual abiding places of the burbot. The eggs of the burbot are small and are supposed to be deposited in deep water. Vast numbers of eggs are spawned by a single fish.

Burbot does not rank high as a food fish, although when salted properly it compares favorably with other coarse species. In the Great Lake region, the livers are sometimes eaten, the rest of the fish beginning discarded as worthless. In some other localities, Montana for instance, the burbot is liked as a food.

MINNOWS.

The minnow family is a very large one embracing as it does more than a thousand species and about two hundred genera. About two hundred and twenty-five species are indigenous to American waters. They are fresh water fishes. In size they range from a very few inches to a foot in length. In eastern waters minnows rarely exceed a foot in length and are for the most part very much smaller. A number of specimens several feet long, are found in the west.

Minnows are very abundant in the waters they inhabit. Their flesh is very sweet but very bony. Commercially they are not of great value, although some of them are highly prized by the boy angler, while the adult regards them as choice live bait for other species of fishes. Some of the species make good aquarium fishes.

